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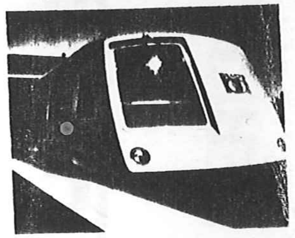

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Summary

This summary addresses major issues considered in the Pittsburg-Antioch BART Extension Study (PAX). The study itself represents over two years of planning and evaluation of future transportation needs in the PAX corridor (see corridor map) within the context of a potential range of growth and development patterns which this region could experience by the year 1990.

The study recommends a BART rail extension which would best serve the type of growth which city and county components of the corridor feel is most consistent with growth policies which they are now in the process of implementing. In addition, the recommended extension is compared to two bus transit alternatives which could also provide the type of public transportation service that would be needed in the corridor in the event a decision is made to postpone or not proceed with the construction of BART to Antioch.

Included in this summary is a description of PAX project and planning process and a discussion of the following major concerns:

- -Why was rapid transit considered?
- -How can rapid transit help?
- -What would it be like?
- -How can it be paid for?
- -What would the corridor future be like without BART?
- -How does BART compare with the no-BART option?
- -What are the next steps?

Detailed information supporting this summary is contained in Sections 1 through 11 of the Pittsburg-Antioch BART Extension Study Draft Final Report. This material is in turn supported by several interim reports developed during the project.

Project Background: The BART plan of 1956 included rapid transit service to Pittsburg and Antioch as part of the overall system proposed for the Bay Area. With BART's 75-mile system now near full operation, attention has increased towards future extensions of BART to Pittsburg-Antioch and other areas of the Bay region.

Coordination of BART extensions and other forms of regional transportation is the responsibility of the Metropolitan Transportation Commission (MTC), formed by the California Legislature in 1970 to plan, coordinate and guide transportation development in the Bay Area. The preparation, adoption, and maintenance of a "Regional Transportation Plan" as a continuous and cooperative process is one of MTC's main purposes.

MTC, BART and the cities of Pittsburg and Antioch entered into a Joint Powers Agreement in the fall of 1972 to study the implications of extending BART from the present Concord BART Station through Pittsburg to Antioch. The parties to this Agreement are all represented on a Board of Control (BOC) which is responsible for the project's administration. Further, Technical (TAC) and Citizen Advisory Committees (CAC) were formed to assist the project staff and consultants throughout the study by reviewing findings and participating in all recommendations made to the BOC. A comprehensive review process was used at the completion of all major progress reports which included presentations before City Councils and several Town Meetings. Results of this study, along with other transportation studies either planned or in progress in the nine county Bay Area by MTC, BART and others, will form the basis of the Regional Transportation Plan.

WHY WAS RAPID TRANSIT CONSIDERED?

Without public transportation improvements, the Pittsburg-Antioch area will likely experience a variety of transportation and environmental problems as urban growth occurs.

More than at any other time in the recent past, the future development of the area is uncertain. Dramatic shifts in trends have been caused by a sluggish economy, the energy shortage, state and federal laws regulating land use, air quality and water quality, and changes in people's attitudes and lifestyles.

In the long run, the nation's economy and capability to increase available energy will necessitate patterns of growth and means of transportation that conserve energy resources. Locally, it will become increasingly difficult to afford the price of maintaining a suburban lifestyle.

Resistance to tax increases for funding roads, sewers, schools and other urban services will make it more difficult for governments to provide these necessities to sprawled growth, which is inefficient to serve. Area residents and governments are likely to be increasingly concerned about maintaining the environmental quality of their communities and preserving rural land.

During the last year, the combined effect of these factors has been to slow the growth of new housing, industry, and commerce, while increasing the rate of unemployment and decline of the older portions of Concord, Pittsburg and Antioch. The permanence of these effects remains to be seen.

Overall travel demand in and out of the corridor could nearly double by 1990. Unless significant improvements to public transportation are made, the choice will be between decreased mobility or a variety of problems associated with continuing almost total reliance on the automobile. Also, as automobiles become more expensive to own and operate, a greater number of residents will become increasingly dependent on public transportation.

HOW CAN RAPID TRANSIT HELP?

A BART extension into the Pittsburg-Antioch corridor would be a major improvement in public transportation; it would provide better regional transportation service and would significantly influence growth and change in the service area.

BART can have an important role in guiding the area's future:

- By providing a major stimulus to redevelopment of downtown Pittsburg and Antioch: Increased land values around stations would encourage more intensive re-use of deteriorated areas of these communities. BART could provide a catalyst for local redevelopment efforts which emphasize revitalization of shopping and commercial areas, higher density housing and development of marinas and specialized recreation activities. Also, opportunities exist for joint use of BART stations and right-of-ways including parks, trails, bicycle paths, day-care centers and in developing clusters of community facilities and businesses within walking distance of BART stations.
- By Helping Redirect New Growth Away from Rural Lands and Back into Existing Urban Areas: The Pittsburg-Antioch corridor is not fully developed and is, therefore, an area where BART can direct growth rather than merely respond to growth. This opportunity comes at a time when both the beneficial and adverse impacts of a rapid transit system are becoming better understood and when attitudes towards controlling growth and legal methods of doing so are changing significantly. BART could increase the

opportunity and attractiveness for public and private expenditures in existing built-up areas and can therefore encourage the kind of growth which promotes an efficient use of land and urban services and can be more easily served by public transportation.

- By Providing Better Regional Mobility for People who will Live, Work or Spend Leisure Time in the Corridor: Unemployment is high in the older parts of Pittsburg and Antioch and industrial employment is declining. BART could increase employment opportunities for residents by increasing accessibility to jobs within and outside of the corridor. At the same time, BART would make it more convenient for people to come into the corridor for jobs, and to enjoy recreational areas in the Delta, and along the rivers.
- By Helping Reduce Potential Use of the Automobile and its Attendant Energy and Air Pollution Problems: By facilitating and serving a more concentrated growth pattern BART could, with adequate feeder bus service and an increased emphasis on non-auto access, reduce overall travel time, the need to own and operate a second or third automobile, and reduce the need for roadway improvements and extensions. These objectives are in conformance with Regional Transportation Planning policies which increasingly concern themselves with placing legal limits on air pollution levels.
- By Attracting New Industrial and Commercial Development: BART would make industrial sites more accessible to regional labor markets, and encourage new commercial development by stimulating residential growth which increases local markets for commercial services.
- By Improving Future Levels of Environmental Quality in the Corridor: While the direct and indirect environmental impacts of extending BART from Concord to Antioch are minimal, the opportunities afforded by BART to preserve and enhance the environment are substantial. However, this will only be possible if city and county officials in the corridor exercise a strong will concerning the regulation of growth and development as a tool to improve future livability and environmental quality.

WHAT WILL IT BE LIKE?

The recommended extension involves approximately 14.5 miles of rail rapid transit system from the Concord BART Station through Pittsburg to Antioch. Four station locations and a transit car yard were adopted by the Project's Board of Control.

Route Description: The route would begin at the Concord BART Station, continuing aerial along the median of a widened Port Chicago Highway to the North Concord Station opposite Sun View Terrace Road. The North Concord Station would be an aerial station with an at-grade concourse. It would serve 5,600 one-way daily trips originating mainly in the North Concord and North Martinez areas. It would also act as a "back-up" station to the central Concord Station. Parking for 500 cars would be provided on the east side of the station.

From the North Concord Station the line would curve around to the east, descending in a subway under the eastbound lanes of a reconstructed SR-4, then continuing at-grade in the SR-4 median over Willow Pass. On the other side of Willow Pass the line would leave the median and run along the north side of the westbound lanes, then curve away from the freeway on an aerial structure crossing the intersection of Port Chicago Highway and Willow Pass Road and into the West Pittsburg Station designed to become the center of a new community. Approximately 5,500 one-way trips would pass through this station by 1990. Parking could be provided for about 700 cars in conjunction with a shopping and community center complex.

Should a decision be made to abandon the Naval Weapons Center prior to construction of BART, the alignment could go through Port Chicago. The North Concord or West Pittsburg Station would then be relocated to serve potential new development in the Port Chicago area.

From the West Pittsburg Station the line would continue on aerial structure with a crossing over the Atchison, Topeka and Santa Fe Railroad, then descend to grade paralleling the tracks. After passing over the Sacramento Northern Railroad tracks, the line would curve to the northeast and ascend to aerial structure in the abandoned Sacramento Northern property. It would then continue on an aerial structure in the median of 8th Street and remain so to the Pittsburg Station. The Pittsburg Station is an aerial station located between Railroad Avenue and East Street. A station located here could provide a major stimulus to the City of Pittsburg's downtown and waterfront redevelopment. This station would have a patronage of about 12,500 one-way trips daily. Parking for over 500 cars could be provided adjacent to the station off 10th Avenue East. Leaving Pittsburg, the line passes through U.S. Steel properties and on aerial structure, paralleling the Atchison, Topeka and Santa Fe Railroad tracks, and continues along the south side of the tracks descending to at-grade approaching the BART Antioch Yard. The main line tracks, which split apart to pass around either side of the yard, come together again as they ascend to cross over the AT&SF tracks.

Shortly after passing the access road to the cannery in Antioch, the line would descend to enter the Antioch Station at-grade on filled land along the San Joaquin River. This recommended station site would provide a linkage between the city and the river currently severed by the railroad and thus be a positive design element in the visual rehabilitation of downtown Antioch. It is estimated that this station will serve approximately 12,600 one-way trips in 1990. Parking for 400 vehicles could be located between 1st and 2nd Streets, west of "I" Street.

Transit Yard: Based on the eventual 2-minute service in and out of San Francisco and taking into consideration a possible extension of BART into San Mateo County, and capacity limitation's of the existing Concord Yard, it was determined that additional train storage facilities would be required. The study recommended a 150 car yard located just west of Antioch. Both the Antioch and Concord Yards would function as storage and maintenance facilities.

Construction Cost Estimate: The total cost of extending BART service and facilities to Pittsburg and Antioch would be $211 million. This estimate represents the total cost in mid-1974 dollars for designing, constructing, and making the extension ready for operation. The level of preciseness of the estimates reflects the degree of detail that was developed in the preparation of the engineering for the line, yard, and systemwide equipment designs made in this study.

Patronage and Revenue Estimates: The Regional Transit Travel Projections Project (RTTPP) estimates that about 36,000 daily trips will be made on the Pittsburg-Antioch BART Extension in 1990, about one-sixth of the 1990 patronage estimate for all of the Concord line. The annual incremental operating cost of providing service for these patrons is estimated to be about $6.5 million. Under the present BART fare schedule, the incremental revenue is about $8.8 million per year.

The net revenue of approximately $2.3 million in 1974 dollars does not reflect the possible effect of inflation on costs or fares and is dependent on estimated patronage projections, fare structures and operating cost assumptions which may vary in the future.

Extension - "C" Line Service Impacts: It is expected that current overcrowding on the Concord-Daly City "C" Line will temporarily be reduced when more trains become available and shorter headways are possible.

Based on 1990 patronage estimates for the "C" Line, the addition of commuters riding BART from the Pittsburg-Antioch Corridor will cause trains to be full (72 seated and 72 standing) between the Orinda and Rockridge Stations.

In order to reduce this overcrowded condition, the following service options exist:

1. Change operations plan from 6 to 4 minute headways on "C" Line; other lines to 8 minutes.
2. Complete the third track under Oakland and operate a Concord to Oakland shuttle.

HOW CAN IT BE PAID FOR?

Transit planners and decision-makers are generally faced with the problem of preparing plans in order to sell someone on the necessity of financing the project. The PAX project is no different; the plan or program must be developed in order to advocate the development of a financial plan using a variety of fund sources. BART began in an era when no Federal or State funds were being allocated for transit. The Federal Government now provides about $1 billion dollars annually for transit capital projects. Additional funds are becoming available as a result of diversion of funds which have traditionally financed highway projects; this trend is expected to continue. At present, however, these funds are not sufficient for the Urban Mass Transit Administration to guarantee full 80% participation in all of the major transit projects in progress or proposed. The amount of federal funds for major capital projects in this region remains a function of both the competitiveness of our plans and the total availability of federal funds. The regional priorities for this project will be determined by the Metropolitan Transportation Commission. The PAX study, one of several being undertaken cooperatively with MTC, is part of a process for making that determination. The trend in funding which allows for greater flexibility in the use of funds from different sources places a much higher level of responsibility within the decision-making process than previously existed. This study was designed to assure participation from the community and decision makers who will be required to implement the plan. Continued support by these participants is essential if the Pittsburg-Antioch BART Extension is to be made part of the regional plan and have a high priority for funding. Preliminary review of fund sources indicate that a BART extension in this corridor is well within the region's financial capability although no specific plan is presented here. In fact, because attitudes and policies toward financing transit are changing, the development of plans such as this one for PAX should not be inhibited by past funding constraints.

What is required is an overall plan of priorities for funding major capital improvements in the region. This plan must take into account both the desirability of particular extensions and also the equity considerations of those who have in the past committed significant tax resources for transit improvements. Both MTC and the State Legislative Analyst are reviewing transit fund sources. This work will undoubtedly be well underway or complete by the time this report is submitted to UMTA for its approval. With this information and information developed from other planning efforts - both regional and project plans - it will be possible to develop a realistic approach to a financing proposal.

WHAT WOULD THE FUTURE BE LIKE WITHOUT BART?

With BART as many as 370,000 persons could be living in the corridor by 1990. Directed by appropriate zoning and subdivision controls, growth would be concentrated back into already urbanized areas allowing for conservation of open space and rural lands. Extension patronage has been estimated at 36,000 daily trips. No major improvements to SR-4 would be necessary.

Without a BART extension, two alternative corridor futures would be possible, assuming different levels of growth and transit service.

(1) Limited Growth Future: This corridor future would consist of a scattered development pattern with a population of approximately 282,000 as compared to a 1974 population of roughly 220,000. The present BART express bus system would be up-graded providing expanded express service. This system would serve 7,600 daily trips to the Concord Station. Only minor improvements to SR-4 would be required.

(2) Trend Growth Future: If current trends continue, the corridor will experience a population increase up to 350,000 persons by 1990. Growth will occur over a wide area of currently undeveloped land, but in a scattered rather than continuous pattern. SR-4 would require expansion to include at least two additional vehicle lanes, and two exclusive lanes for buses. Bus transit operating on exclusive lanes would allow 11,600 daily passenger trips to be made at the Concord Station from the corridor.

One of the basic issues of Extension versus Non-Extension concerns itself with how and at what rate growth should occur.

The availability of relatively inexpensive land, low cost home buys, nearby recreation, good climate and express bus service to the Concord BART Station will make development an attractive proposition. However, significant changes in the national and local economy have taken place: energy shortages and uncertainties, the rapidly increasing cost of automobile purchase and maintenance, increasing building costs and limited investment capital, have all contributed to a general slow-down in growth in the Bay Region which has in turn impacted the Pittsburg-Antioch corridor. Also, many of the policies, goals and decisions which are presently being made by local jurisdictions reflect a commitment to limited or concentrated growth: pre-commitments including preservation of open space and agricultural lands, urban limit lines, extension of utilities only to areas already committed to development, and efforts by cities to attract development and redevelopment opportunities directed to stabilizing downtown areas.

Ultimately, corridor growth will be limited by existing utilities and to a larger extent by the present road network. Expansion of SR-4 would greatly improve access in and out of the corridor and thus facilitate growth, but that expansion now appears unlikely for the following reasons:

(1) More Stringent EPA Regulations: 1975 EPA regulations will make it increasingly difficult to gain approval of any major highway project such as SR-4;

(2) SR-4 Funding Uncertainties: Funding for SR-4 appears unlikely in view of the low priority consideration given to that project by the Metropolitan Transportation Commission (MTC) and California Department of Transportation.

Therefore, without major regional policy changes concerning highway funding and environmental acceptance, the corridor without a BART extension would most likely experience a limited level of growth.

HOW DOES BART COMPARE WITH THE NO-BART OPTION?

Two bus alternatives were examined in the context of the Limited growth and Trend Growth Futures described for the No-BART option.

The two bus alternatives presented: (Bus Alternative 1a - Limited Growth), and (Bus Alternative 1b - Trend Growth), are consistent with the assumptions and patronage data generated during the Regional Transit Travel Projections Project (RTTPP).

Costs: The estimated costs for Bus Alternatives 1a and 1b are $20.8 million and $108.2 million respectively, compared to $211 million for BART. These costs include initial bus fleet purchase and improvements to SR-4. Additional costs were added for replacing the bus fleet 2.5 times over a 30 year period to approximate the life of a BART car.

For the purposes of comparison with BART, system capital costs were annualized assuming 40 year bonds at 7% interest and then added to annual operating costs and revenues. The resultant costs per passenger trip accounting for the larger patronage volumes projected for BART are $1.20 (1a), $1.61 (1b), and $1.34 (BART).

Service Characteristics: The principal attraction of BART would be the 12-minute service which could not realistically be achieved with either Bus Alternative. For commuters, direct BART connection from Antioch and Pittsburg to other stations on the BART system would give a distinct advantage over the Bus Alternatives. On the average, an express bus trip from downtown Antioch to the Concord BART Station would take between 25-35 minutes longer than the same trip on BART.

For persons living south of SR-4 and working in the industrial belt to the north, the Bus Alternatives could have a distinct advantage, although it is assumed that with BART, adequate local bus service could also be provided to serve these locations.

Community Impacts: Relocation impacts with 1a would be minimal. However, at least 200 housing units and five businesses and several community facilities would have to be acquired for SR-4 expansion in Bus Alternative (1b); nearly four times as many houses and three times as many businesses than BART.

Direct noise level comparisons between BART and the Bus Alternatives would be insignificant except where SR-4 widening occurred. BART would place an additional noise source within the corridor exposing more land uses to high noise levels.

Additional freeway lanes as proposed in Bus Alternative 1b will have the effect of visually reinforcing the existing separation of communities north and south of SR-4. With BART, visual impacts and community separation would be greatest along Port Chicago Highway and through Pittsburg.

Natural Resource Impacts: The direct impacts of Bus Alternative 1a (minimal improvements to SR-4) will be insignificant. With Alternative 1b, expansion of SR-4 to accommodate exclusive bus and additional vehicle lanes will create 155,480 lineal feet of new, and reinforce 2,912 lineal feet of existing impacts to critical wildlife habitats and plant communities, slope, seismic, fire and flood hazards, agricultural, water, visual and recreation resources. BART line and yard would create 65,100 lineal feet of new and 91,400 lineal feet of reinforcing impacts.

Growth Inducing Impacts: Growth inducing impacts with Bus Alternative 1a would be minimal because growth would take place in areas already committed to development. SR-4 expansion with Bus Alternative 1b would greatly improve mobility in and out of the corridor. An expanded SR-4 is consistent with and would facilitate the trend growth. It is the growth pattern - not the transportation system - which will have the most significant environmental consequences.

Growth spreading into rural areas could cause considerable and irreparable damage to the natural environment, affecting about 4,650 acres of valuable biological resources and about the same number of acres of hazard areas subject to slope failure.

Providing zoning, subdivision controls, limitations on urban services expansion, and other government actions that are assumed to take place with the extension of BART are strictly adhered to, there would be few adverse impacts on the natural environment since new growth would be directed away from rural lands and back into existing urban areas.

Air Quality and Energy Requirements: Energy requirements and air quality are primarily a function of the nature and location of the growth. With limited growth, increases in energy consumption and corridor air pollutants would be moderate. With trend growth more people will be using their cars to access dispersed job locations outside the corridor and for short trips such as shopping, and community services. The latter would result in higher energy consumption and pollutant levels.

With BART more people could live closer to transit and employment locations within the corridor and thus within the region. Also clustered development patterns would make walking, bicycling and local transit more attractive for short trips and station access. The net effect would be to reduce overall energy consumption and air pollutant levels below anticipated "trend" growth levels.

If growth does not occur in the Pittsburg-Antioch corridor it is assumed that it would be absorbed into other parts of the Bay Region. In this event, changes in air quality levels and energy consumption increases would vary by the location and type of growth. If growth is allowed to occur in areas poorly served by transit or in a manner which would preclude adequate transit service, regional air quality will be worse and energy consumption higher than with a BART extension to Pittsburg-Antioch.

WHAT ARE THE NEXT STEPS?

The next phase of the project will answer the questions "Should BART be extended?", and if it is "When and How will the extension be constructed. These tasks will require continaed participation by city officials, community groups, and residents of the corridor to be successful. Also, BART and MTC's responsibilities will intensify as lead agencies in the implementation process. A Pittsburg-Antioch BART extension raises many issues concerning the rate and character of growth which could take place in the corridor. During the review period, which follows distribution of the Final Draft Report, corridor committees will be able to decide what kind of growth future they want and whether BART will be part of that future.

Assuming citizen and governmental endorsement of the extension, the next steps will include:

Project Approval: Following local agency, community and Urban Mass Transportation Administration (UMTA) review, and assuming acceptance of the findings, a Final Report will be published. Recommendations of PAX and the other transportation studies in the nine-county Bay Area will be considered by MTC for incorporation into the Regional Transportation Plan.

Pre-Construction Strategies: Land Use Planning: While the transportation service characteristics are largely a matter of how the extension is designed and located, the growth-shaping potential of BART depends substantially on coordinated government actions with BART. Some actions which local municipalities may take to insure the preservation of transit and urban development goals that the extension is designed to meet include:

1. Preserve BART right-of-way;
2. Encourage desirable public and private development around stations;
3. Make zoning and other land-use decisions to encourage clustered growth patterns;
4. Develop programs and solicit funds which will help minimize adverse local impacts and enhance the economic benefit of a BART extension.

Project Monitoring and Community Involvement: Every effort should be made by the cities to include area residents in planning and land-use decisions that will affect city and regional growth. The Citizens Advisory Committee is encouraged to develop a strong civic involvement in these matters to ensure that their input and the interests of this project are considered.

Project Funding: Priorities for funding is the responsibility of MTC. Once funding priorities are set, the project material required for formal grant application, such as environmental reports, should be prepared.

Final Design and Construction: Either prior to or during an early phase of the final design stage, certain decisions will have to be made to resolve issues addressed in this study. These include:

1. A Port Chicago routing in the event that the U.S. Naval Weapons Station properties are abandoned;
2. Level of coordination and mitigation with development interests around West Pittsburg BART Station;
3. The desirability and feasibility of a subway alignment through Pittsburg;
4. Alternative alignments and station locations in Antioch.

After completion of these analyses and approval of a formal grant application by the region and Federal Government, the project can be engineered and constructed.

Project Advocacy and the Regional Plan: Implementation of a desirable extension will depend in part on continued public support. A strong advocacy position on the part of local officials, local interest and citizen groups is required to assure that PAX will be considered as a high priority improvement among the region's transportation needs.

Section 1: Introduction

Project Background Organization and Community Participation

The Pittsburg-Antioch BART Extension Project (PAX) studied the feasibility and impacts of an extension of the existing Bay Area Rapid Transit system from Concord into the Pittsburg-Antioch area.

The project examined various alternative BART extensions within the broader context of various growth futures for central and eastern Contra Costa County. This report examines the process through which a final BART alignment was selected, and compares the selected route with the alternative of not extending BART beyond Concord. The basic philosophy of the project study was that a BART extension would not only provide the corridor with a high level of regional transportation service, but would also greatly influence future growth patterns.

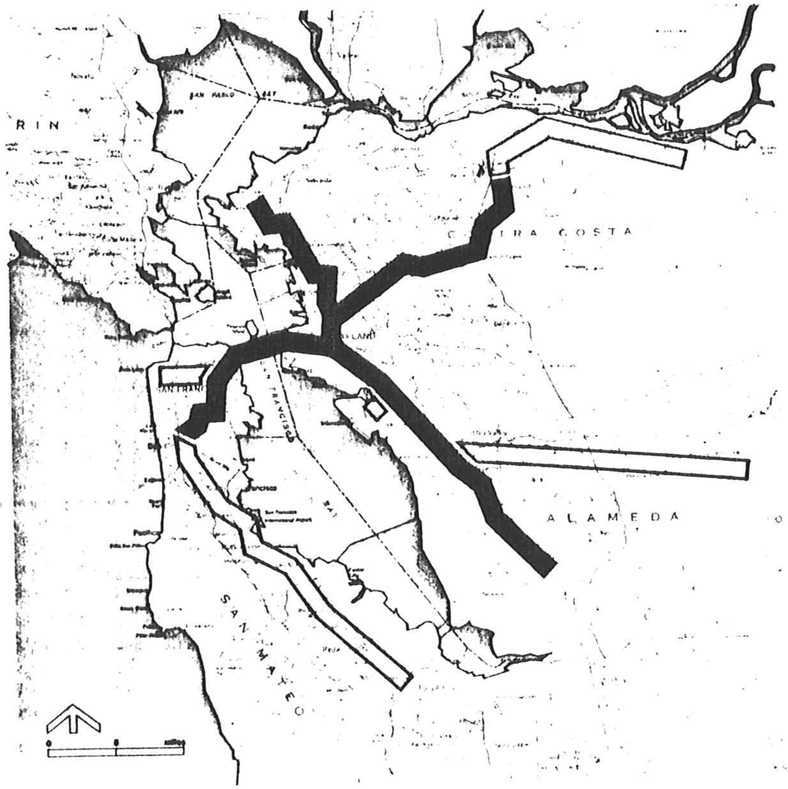


Figure 1-1 BART Transportation Plan

■ First Stage - 75 mile system

☐ Extensions Under Study

☐ Pittsburg-Antioch Extension

This is especially valid considering the PAX study has tried to reach conclusions about extending BART at a time when the future of this part of Contra Costa County can still turn in various directions. For this reason both the BART extension and No-BART alternative were evaluated within the broader context of potential area growth patterns.

The project study boundaries consist of the commuter residential areas of southern Martinez on the west, Oakley and Brentwood on the east, Concord on the south, and the Sacramento and San Joaquin Rivers on the north (see Figure 1-1). Pittsburg and Antioch were the first towns established in the corridor and had their beginnings in the mid-1800's as mining and fishing communities. Though the general area remained agricultural, industry did begin to locate around the turn of the century along the rail lines constructed near the river shores. In conjunction with this economic diversity, more people, mainly factory workers, began to reside in the area. However, it was not until 1940 that the population increased significantly due to the boom related to the Second World War.

Along with this growth in population came the development of an improved road network. The corridor area is bisected east-west by State Route 4, which will soon be up to freeway standards from Antioch to Interstate 80 along San Francisco Bay. The westerly portion of the area is well served by the recently completed north-south Interstate 680 route and a short piece of State Route 24 in Concord.

Through the 1960's and the early 1970's the population grew dramatically, not in the older, established areas, but on open land surrounding the corridor communities.

If present growth trends were to continue, by 1990 suburban communities will have extended far into the hills surrounding Concord and south of Pittsburg and Antioch.

Farming and grazing land will have disappeared in many parts of East County, the area around Oakley and Brentwood will be subdivided with individual houses scattered elsewhere. More middle income families will live in low density neighborhoods in east Concord, southern Martinez and the hills south of Pittsburg and Antioch. Many working members of families will commute to jobs elsewhere in the region, but will still rely on the automobile for local travel. To handle this increase in the use of the private auto, will require the widening of SR-4 from West Pittsburg to Antioch and the up-grading of various other major arterials. The older areas of Concord, West Pittsburg, Pittsburg and Antioch will continue to decline, although industries along the waterfront will continue to provide some jobs to local residents. However, there are significant indications that there is growing concern about present growth trends. People who prefer today's low density suburban style of life are beginning to resist tax increases to pay for roads, sewers, schools and other urban services provided by governments in response to inefficient spread growth. Corridor residents and governments are increasingly concerned about preserving rural lands and maintaining environmental quality. State and federal laws regulating land use, air and water quality, and requiring environmental impact statements are becoming more strict. It is getting more difficult and more expensive to use the automobile.

In the long run, the nation's

economy and capability to increase available energy will necessitate patterns of growth and means of transportation that conserve energy resources. Locally, it will become increasingly difficult to afford the price of maintaining a suburban lifestyle.

If these and other changes in attitude continue, the direction of growth in central and East County during the 1980's may be toward redeveloping older areas of Concord, Pittsburg and Antioch so that people live in more concentrated communities which are more efficient to serve, absorb fewer hills and agricultural lands and rely more on walking, bicycling and public transportation for travel.

Regardless of what happens in the future, without public transportation improvements of some kind, the area will likely experience a variety of transportation and environmental problems. Overall travel demand could nearly double by 1990. The choice will be between decreased mobility or experiencing the variety of problems that are associated with continuing almost total reliance on the automobile.

PROJECT BACKGROUND

BART's early planning included rapid transit service to Pittsburg and Antioch as part of the overall system proposed for the Bay Area. As BART's 75-mile system nears full operation, attention is increased toward future extensions of BART to Pittsburg-Antioch and other areas of the BART District. An area map, Figure 1-1, shows the locations of the various BART extensions which are being studied. Coordination of BART extensions, and other forms of regional transportation is the responsibility of the Metropolitan Transportation Commission (MTC), formed by the California Legislature in 1970 to plan, coordinate and guide transportation development in the Bay Area. The preparation, adoption, and maintenance of a "Regional Transportation Plan" as a continuous process is one of MTC's main purposes. In developing and maintaining its regional plan, MTC coordinates transportation planning efforts of local, state, and federal agencies, and distributes California Transportation Development Act funds in the Bay Area.

MTC, BART, and the Cities of Pittsburg and Antioch entered into a joint-powers agreement in the fall of 1972 to study the implications of extending BART into a corridor from the present Concord BART station to Pittsburg and Antioch. Results of this study along with some thirty other transportation studies either planned or in progress in the nine-county Bay Area, will form the basis of the Regional Transportation Plan.

The project was funded in part by a technical study grant from the U.S. Department of Transportation, Urban Mass Transportation Administration, locally administered by MTC. The grant was matched by funds and in kind services from BART and the Cities of Pittsburg and Antioch.

PROJECT ORGANIZATION

To oversee the project, a Board of Control was appointed, consisting of four members from the Bay Area Rapid Transit District, three members from the Metropolitan Transportation Commission and one member each from the Cities of Pittsburg and Antioch. Parsons Brinckerhoff-Tudor-Bechtel, a joint venture of consultants, in association with Wilbur Smith and Associates, and Ingmire/Patri, Inc. was selected to perform the study. To provide continuous local citizen and technical involvement to the project, Citizen and Technical Advisory Committees were established. A chart of how the project organization functioned is shown in Figure 1-2.

The study itself commenced in August, 1972 and was divided into three main work phases. The major activities which were completed during each of these phases are illustrated in Figure 1-3, the project work program.

During Phase I, five separate reports were published corresponding to various tasks:

Issues Report: (December 19, 1972) posing the problems and questions to be addressed in the study.

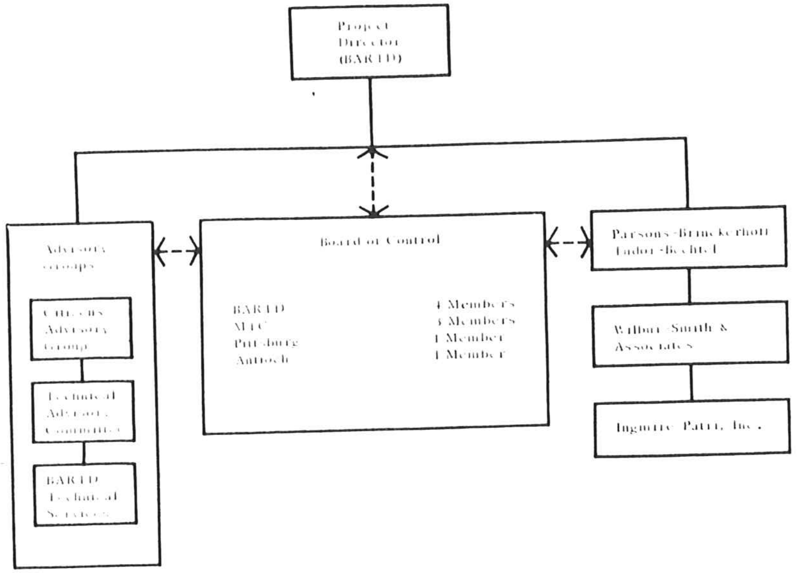
Evaluation Criteria Report: (March 16, 1973) describing methods and criteria for evaluating BART extension alternatives.

Identification of Routes and Stations Report & Extension-Growth Alternatives Memorandum: (March 6 and May 2, 1973) identifying seven alternative BART extensions and their associated corridor growth patterns.

Evaluation of Extension-Growth Alternatives Memorandum: (July 9, 1973) evaluating these alternatives and providing the information leading to the Board of Control's decision on September 19, 1973, to adopt two extension alternatives for further planning.

After the recommended extension was selected by the Board of Control in June, 1974, Phase II began, encompassing a detailed conceptual design and impact analysis of the selected extension and a comparison of the ramifications of it with the option of not extending BART beyond Concord.

Figure 1-2. Project Organization



The information developed during Phase II is summarized in this Draft Final Report, the preparation and publication of which is the first step in the final phase.

COMMUNITY PARTICIPATION

Advisory Committees

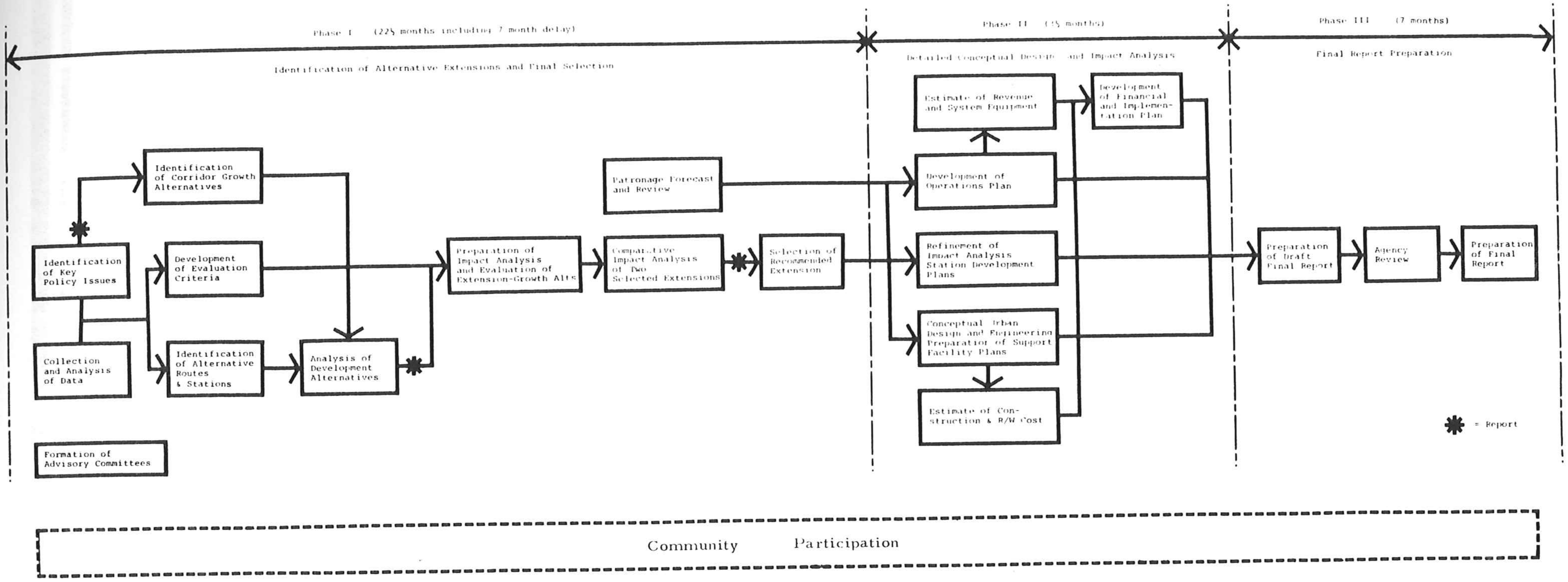
In an attempt to maintain local input and direction during the course of the project, a procedure for retaining regular citizen and governmental review was established through the creation of Citizen and Technical Advisory Committees.

A Citizens Advisory Committee representing the Cities of Concord, Clayton, Martinez, Pittsburg, Antioch, and Brentwood and Contra Costa County was elected with a maximum of six members from each jurisdiction. Generally, open meetings were called by the City Council and Manager in each municipality and all persons interested in the project were invited to attend and serve on the Citizens Committee. At the meetings, citizens interested in being on the Committee submitted their names and the election of regular members and alternates was voted on by all present.

A Technical Advisory Committee of appointed members was also established representing the cities, the County, MTC, the California Department of Transportation, the various railroads involved, Solano County, the East Bay Regional Park District, and the U.S. Naval Weapons Station. Members of the committee were appointed by each agency from their respective staffs.

Both committees worked closely with the Project Director and the consultant staff. They reviewed methods and findings at the beginning and end of each task, carefully reviewed all planning matters, and finally assisted in

Figure 1-3. Project Work Program


Phase I (22½ months including 7 month delay)
Identification of Alternative Extensions and Final Selection
Phase II (15 months)
Detailed Conceptual Design and Impact Analysis
Phase III (7 months)
Final Report Preparation
Identification of Corridor Growth Alternatives
Identification of Key Policy Issues
Development of Evaluation Criteria
Collection and Analysis of Data
Identification of Alternative Routes & Stations
Analysis of Development Alternatives
Preparation of Impact Analysis and Evaluation of Extension-Growth Alts
Patronage Forecast and Review
Comparative Impact Analysis of Two Selected Extensions
Selection of Recommended Extension
Formation of Advisory Committees
Estimate of Revenue and System Equipment
Development of Financial and Implementation Plan
Development of Operations Plan
Refinement of Impact Analysis Station Development Plans
Conceptual Urban Design and Engineering Preparation of Support Facility Plans
Estimate of Construction & R/W Cost
Preparation of Draft Final Report
Agency Review
Preparation of Final Report
✱ = Report
Community Participation

selecting the recommended BART extension. Although the BART extension Board of Control made the major decisions, opinions and guidance from the advisory committees provided additional input for the Board in making those decisions.

City Staff, Public Agency and Special Group Contacts

Throughout the project, coordination was maintained with both the planning and engineering staffs from those cities falling within the corridor study area. In addition, meetings were held in both the preliminary and more detailed stages of route and station development with personnel from public agencies directly involved with the project, such as District 4 of the State of California Department of Transportation and the U.S. Naval Weapons Station. Coordination was also established with owners of major property holdings through which the BART line was being considered for extension; Sacramento Northern Railroad, Atchison, Topeka and Santa Fe Railroad, Southern Pacific Transportation Company, Shell Oil Company and PG&E. In addition, discussions were held with groups having a general interest in the corridor area, for example, the Contra Costa Joint Chambers of Commerce.

Press Coverage

A summary of the project effort was published in the form of an eight-page newspaper in April, 1974 to inform the public of how BART could become a part of the area's future. Over 30,000 copies of the paper, entitled "Pittsburg-Antioch BART Extension Project Summary Report", were printed. They were distributed to the general public by inserting them in two of the local newspapers, the Antioch Ledger and the Pittsburg Post Dispatch. To improve the circulation in the Concord/Martinez area, additional copies were hand delivered to local shopping centers, supermarkets, and colleges. This report, supplemented by notices sent to all the local newspapers, provided area residents with a summary of the study to date and informed them of all public meetings at which time they could obtain additional information and put forth their comments.

Section 2: Evaluation Criteria

In the final selection of recommended alignment and station site locations for the BART extension, the most valuable tool was the evaluation criteria developed in early 1973. These criteria encompassed items to be considered in analyzing the relative merits of a set of alternative extensions, and, ultimately, in comparing the selected line with the situation which would occur in the corridor without a rapid rail transit extension.

The results of the study of applicable criteria were published in the "Evaluation Criteria Report" which discussed the information needed for the evaluation of the alternatives and the way in which values or standards would be developed and used in weighing the information. This section contains a summary of that report beginning with a brief description of some of the characteristics and potentialities of rapid transit which should be understood in order to apply the criteria.

DEVELOPMENT OF CRITERIA

The term "criteria" implies standards or objectives against which the performance and effects of alternative BART alignments can be assessed. Since the Pittsburg-Antioch corridor is an area which has experienced steady but scattered growth since the Second World War, certain general standards do exist which were used in the evaluation process.

The "Issues Report, December, 1972", indicated potential conflicts between the objectives of various interests in the corridor. For example, the objective of some local plans and groups is service to the downtown areas of older communities while for others it is service to developing suburban areas. The purpose of the planning and evaluation processes of this study was intended to identify the "trade-offs" between conflicting objectives associated with BART extension alternatives, and to enable refinement of the alternatives during evaluation. This process required information describing alternatives, trial. design work and discussion of the goals and values of interest groups which might be affected by the extension.

Two steps were necessary to produce evaluation criteria which were uniquely suited to the Pittsburg-Antioch corridor. First the "measurement" part of each criterion was defined. This measurement part established what information was necessary to make an evaluation. It was in the form of a check list of factors or "descriptors" by which the effects of each alternative could be described. For example, the descriptor part of evaluating BART noise impact was a measurement of noise levels at different distances from the transit line. Secondly, it was necessary to determine whether the measurement indicated either a positive or negative impact. This involved assigning a value to the descriptor. The value component was established from the judgement of the study participants, based upon such standards as presently exist, the objectives and concerns of all the interest groups involved, and upon the information and design concepts developed for the alternative line segments and stations during the planning process.

RAPID TRANSIT CHARACTERISTICS

Before the criteria "descriptors" and development of relative values are discussed further, it is important to establish an understanding of a rapid transit system's major characteristics and capabilities. These operational characteristics and the resulting geometric design limitations along with the service capabilities of a rail system explain many of the direct and indirect impacts of the alternatives to be evaluated.

A rapid transit system has relatively inflexible operational design criteria which tend to influence the location of lines and stations. The impacts on natural and community environments will vary significantly between alternatives because of the actual physical location of the line and stations.

Alignment Design: There are three general types of line and station configurations for the BART system: aerial, at-grade and subway. A line can change from one type of construction to another only in a gradual manner unless there are favorable abrupt changes in topography. This means a transition from an aerial to a subway alignment over flat terrain may require a substantial distance - often as much as a half a mile, at a maximum sustained grade of three percent. BART trains traveling at a maximum speed of 80 miles per hour between stations require a distance of about one mile to make a 90 degree turn. A minimum curve radius, under ideal vertical conditions, of 3,000 to 4,000 feet accommodates a speed of 80 miles per hour between stations. Within 1,000 feet of a station, curve radii can be reduced, however, since speeds of 55 miles per hour are required in those sections. In addition, all stations must be on tangent horizontal and vertical alignment throughout their 700 feet length and usually for 150 to 200 feet beyond each end. The maximum allowed
grade through a station is onl
1.0 percent. In the case of
vertical curvature along the
lines between stations, desig
are greatly affected by the tr
speed and the tightness of the
horizontal curve if it exists a
that point.

General Station Influence: Ra
rail transit affects the directi
and level of population growth
increasing mobility and provi
high speed, comfortable trans
tation. Development or redev
ment tends to be stimulated in
immediate vicinity of stations
New development tends to be
stimulated within convenient
travel distance of stations. T
implications of this characteri
including the environmental
considerations raised by statio
stimulated growth, are of vital
significance to individual
communities and to the Bay Ar
as a whole.

Some impacts will be felt
throughout the corridor, regar
of specific route and station
locations. Other impacts can
depending upon where the route
and stations are located, how th
are designed and local land use
decisions. Stations can be grou
into two basic functional types:
1) Stations serving activity cen
emphasizing pedestrian access.
This type requires high people
densities in the station vicinity
can have intensive development/
redevelopment impacts.
2) Stations serving large reside
areas emphasizing local automob
or bus access and ample parking
This type tends to stimulate ver
extensive and spread growth. O
course, they can also stimulate
high-density multi-family develo
ment adjacent to the station but
their accessibility to the general
area is more important.

Activity center stations, becau
of the nearness of jobs, shopping

and services, would encourage travel on BART to the corridor from elsewhere in the region. Automobile access stations primarily serve commuters living in the corridor. Feeder systems can greatly increase the flexibility of stations to serve both activity centers and large residential areas.

CRITERIA DESCRIPTORS

The planning and environmental information and design concepts which were compiled for the corridor as a whole and for each alternative line segment and station location corresponded to five major categories of criteria descriptors and values. These categories were:

1) Community Impacts
2) Development/Redevelopment Potential
3) Environmental Impacts
4) Patronage
5) Right-of-Way, Construction and Transit Operations

The criteria within each category and the way in which they were used in the actual evaluation process are listed and briefly described as follows.

COMMUNITY IMPACTS

Relocation Requirements: Acquisition of right-of-way for a BART extension would result in the direct displacement of housing, businesses and other activities at actual line locations. An extension would also contribute indirectly to displacement of existing activities by stimulating redevelopment in other areas of the corridor.

Housing and businesses directly displaced by the extension would be relocated according to the U.S. Department of Transportation regulations under the "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970", as amended. The Act requires relocation of persons displaced from their homes, businesses, or farms by federal and federally assisted programs into an equal or better situation. California State Law has similar requirements for relocation resulting from public land acquisition in the State. However, the indirect displacement which may result from changes in land values or private redevelopment encouraged by the extension are not subject to federal or state relocation requirements.

To evaluate the direct displacement impacts of extension alternatives, it was necessary to establish fairly specific route and station alignments. Where the alignments would displace existing houses or businesses, these were indicated in the evaluation.

Displacement of housing and businesses due to the indirect impacts of an extension could not be measured specifically. However, the indirect displacement which may result from changes in land values or private redevelopment encouraged by the extension are not subject to federal or state relocation requirements.

Noise Impacts: BART trains transmit noise into the surrounding area. Though they are quiet by comparison with other transit systems, at certain places along the route noise may become an issue. Traffic noise is also generated in the vicinity of BART stations. Noise levels depend on the alignment, type of support structure, train speed and the number of cars. The amount of noise decreases in relation to the distance from the track. At twenty-five feet there is an appreciable difference in the noise generated by a train on an aerial structure and one in a deep cut. Perception of noise and sensitivity to it are also functions of noise frequency, type of adjacent land use and a variety of physical and natural conditions.

The evaluation of urban noise impacts involved determining the number of existing houses, schools, hospitals and other noise sensitive areas within varying distances from the alternative extension alignments. Noise levels to which these activities would be subjected were estimated based on the findings of the BART noise studies(1) and different assumptions regarding the use of noise barriers. For the purposes of this project, no field measurements were made of ambient noise levels in the areas through which the alternatives pass.

Loss of Privacy: Where the BART extension alignment is at-grade or on aerial structure, riders would have a view of adjacent areas. There has been little study to determine whether people living or working near a rapid transit line are bothered by this loss of privacy. However, in light of this possibility, an evaluation was made of places along the alternative alignments which would be exposed to the view from the train.

Community Disruption: This category relates to the impact of the type of construction or physical configuration on the communities of the corridor in terms of appearance, urban form, and the creation of barriers.

In its aerial alignment, BART is highly visible. However, the modern BART system is very different from traditional transit lines, being carried on an attractive ribbon-like structure, with fewer large supports.

At-grade lines require ground fences to prevent access to trains and high voltage rail along the entire right-of-way. For this reason, at-grade lines restrict cross-corridor movement, requiring underpasses or overpasses, and present visual as well as physical barriers. In this category, there are several variations, however, which create rather different conditions with respect to visual impacts and physical barriers. The three major variations of the at-grade profile are: embankment, on-grade or existing ground, and cut. The last two types of construction are less immediately visible and offer the opportunity for lower profile stations than aerial structures.

Subway lines may be constructed by driving tunnels below the earth's surface or by cut-and-cover boxes which are built in an excavated trench and then covered. Subway lines are practically invisible but generally bring substantial disruption to the community during the construction period and usually require extensive relocation of underground utilities along the alignment.

Access: The extension stations would generate additional traffic on local arterial streets in the station vicinity, and would affect other traffic patterns within the corridor. To evaluate the extension impact on traffic, an analysis was made of existing and planned street capacities in the vicinity of stations. Existing traffic volumes and constraints were mapped to determine whether surplus capacity could accommodate both BART destined and general traffic in the future.

The specific analysis of BART extension traffic impact eventually required patronage projections for each station to be made available for the two recommended alternatives by the Regional Transit Travel Projections Project, Task III tests. This subject is discussed in Section 6.

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Urban Design: For the purpose of the current evaluation, the urban design aspects of the alternative were described where they were felt to produce community opportunities, but were not treated as a separate criterion. Specific urban design plans were also developed for station areas in the conceptual design phase.

DEVELOPMENT/REDEVELOPMENT POTENTIAL

Conformance with Plans and Goals: Many of the plans and goals of public agencies with planning jurisdiction in the corridor refer to the extension route, the appropriateness of its growth generating effects, and the desirability of the transportation service it provides. The project reviewed public plans and policies for the corridor. These provided the basis for the development strategies described in Section 4 of the report.

The market for redeveloped or revitalized downtown areas in connection with stations and the potential for new jobs, housing, business, recreation opportunities and social services reasonably to be expected as a result of the extension were examined.

The likelihood of particular station locations and possible future station hookups on lines through presently undeveloped areas which would stimulate new residential development depended upon assumptions as to amount of parking and access, land use controls and decisions including plans, ordinances, availability of utilities, and environmental impact statement requirements. The cost of new services and new taxes was also generally estimated and compared.

Both general plans and transportation planning for the corridor are in a dynamic stage. The general plans for Contra Costa County, Martinez, Pittsburg, Antioch, and Brentwood are undergoing comprehensive revision and Concord is adding the new elements to its General Plan required by California State law. The Metropolitan Transportation Commission is in the final stages of formulating a regional transportation plan and other transportation facilities plans affecting the corridor are also under way.

The purpose of evaluation according to this criterion was to assist the various jurisdictions now planning for the corridor by showing how the various plans and policies they are considering could be combined with BART into cohesive strategies to guide corridor growth. Although descriptions were made indicating where extension alternatives would be in conflict with known plans or goals, no attempts were made to describe instances where the plans and goals of various jurisdictions were not consistent with each other.

Joint Use: Extension stations and line configurations were generally examined for their potential for incorporating parks, day care centers, shops, parking lots, community facilities and other activities planned by local governments in the extension right-of-way or stations. However, no specific determination was made of the feasibility of financing and implementing these potentials. In addition, opportunities for joint use of transportation corridors, such as freeways and railroad corridors, and of the extension line itself were explored. Aerial BART lines allow use of the ground below for parking and linear parks, as has been done with a portion of the existing system in Albany, while air-rights above subway alignments can be used for a variety of activities.

Social Programs: A BART extension and local bus feeder transit serving extension stations could provide transportation to educational, recreational, and health programs. These social programs were inventoried and the potential for clustering future social services around extension stations was also evaluated by an analysis of local plans and improvement programs.

Indirect Development: According to its ability to stimulate or reinforce redirected growth, a BART extension would have a range of indirect growth impacts. Section 4 describes the projections of growth which could result from BART extension alternatives in conjunction with other land use control and public investment decisions. The population, employment, land use and public works and services characteristics of the alternative projections provided the basis for assessment of other indirect impacts due to new BART stimulated growth. These indirect effects of transportation facilities are frequently more significant than direct impacts.

ENVIRONMENTAL IMPACT

Each extension alternative and associated growth pattern was evaluated according to ten environmental criteria by computer assisted map overlay comparisons. In the case of lines and yards a simple measurement of the length in conflict with the mapped environment criteria was used. For stimulated growth patterns, areas of conflict were measured in acres, although length was the measurement used for faults and some fire hazards.

The ten criteria, which were grouped according to four categories; biological resources, hazards, agricultural and water resources, and visual and recreation resources, are generally described below.

Biological Resources: The study defined critical plant and wildlife communities in the corridor.

Marsh and riparian vegetation, woodland-grassland, chaparral and certain conifer tree stands were defined as critical plant communities, because they are unique, easily harmed, and important for wildlife, rejuvenating soils, erosion protection or slope stability.

Some plant communities, including marshland riparian and some woodland communities, provide essential protection and food for a wide variety of terrestrial and aquatic wildlife. These communities were defined as critical wildlife habitats. Critical wildlife habitats are rare in the corridor, except for the large area including Mt. Diablo and the adjoining foothills. The survival of many large animals and selected bird populations depends upon preserving such extensive, remote and undeveloped lands.

BART extension alternatives and urban growth stimulated by BART could significantly harm or destroy both critical plant and wildlife communities. BART structures and construction can permanently change surface water run-off and increase erosion and sedimentation of waterways. Urban development has similar impacts and significantly increases the volume, flow, and pollution of run-off by covering large areas with buildings, pavement, lawns, and other irrigated or impermeable surfaces. These changes and direct removal can have significant impacts on critical plant and wildlife communities, especially of aquatic species. High frequency BART train noise and new urban noise, particularly traffic and industrial noise, also can cause severe impacts in wildlife habitats which are now relatively free of man-made sound.

Critical wildlife and plan community areas which would be affected by alternative BART extension stations, lines, yards and associated urban growth were measured for the evaluation of biological resource impacts.

Hazards: Potential landslide areas, seismic hazards, likely flood areas, and fire-prone areas were defined and evaluated according to their hazard to and from a BART extension and related urban or suburban growth.

1) Landslides: Potential natural landslide areas included potential slide areas mapped by geologists; steep slopes with poor soil conditions, including high erosion, poorly consolidated and highly weathered bedrock and areas where landsliding has occurred. The balance of factors which keeps these potential slide areas stable is easily altered by new urban development or standard construction methods for BART. For example, earthmoving for houses and roads at the bottom of a slope can remove the support for soil and rock higher up and cause gradual or abrupt landsliding.

2) Seismic Hazards: Active faults which could rupture and areas which are likely to shake the most in an earthquake were defined as the two types of seismic hazard. These areas were located using mapped surficial deposits information and geological reports confirming or tentatively classifying faults.

3) Flooding: Flood prone areas were found to be mainly marsh and low-lying areas at the mouths of water-courses, based on information about flood control facilities, historical flooding and soils conditions. Covering of naturally absorbent soils by buildings, pavement, lawns and other urban surfaces causes more water to run-off, causing more frequent and rapid flooding. This hazard is particularly real in the flat lands of East County, where standard storm drain systems could only carry more run-off faster to the flood prone areas at the Bay edge.

4) Fire: Stands of chamise-chaparral, woodland-chaparral, peat in flat marshland and other easily ignited plant communities, along with dry sunny slopes and steep slopes in areas contribute to serious fire hazard conditions on the higher foothills, Mt. Diablo and in many other areas of the corridor. The BART lines and stations do not pose a fire hazard, but BART-stimulated developments, particularly low density homes, increase the risk of fires starting and are very difficult and costly to protect.

Agricultural and Water Resources:

1) Water Resources: All surface and subsurface waters within the study area are assumed to be valuable resources. Many watercourses and some aquifers have been damaged by past urban and industrial use and agricultural practices, but all of these resources are not necessarily "lost" and many may be worthy of protection from further damage.

Surface waters include Suisun Bay, San Joaquin River, Bay edge estuaries and channels, and upland freshwater perennial streams and reservoirs. Watershed mismanagement can reduce the value of these water bodies as aquatic wildlife habitats, as recreation land areas and, in the upland areas, as potable water sources. The quality and quantity of aquifers may be similarly damaged. As part of a Delta-wide hydrologic system, aquifer areas are a basic subsurface water supply to marshland and riparian vegetation communities along Suisun Bay, the San Joaquin River and in low lying valleys. Additionally, aquifers are still the source of potable well water in the East County.

The possible interruption of broad areas of subsurface drainage by BART at-grade and cut-and-cover lines would have the effect of impounding or redirecting and concentrating the water movement to lower areas. Surface run-off may similarly be concentrated and redirected by the yard and the at-grade line, specifically, via gutters normally edging the line to drains on the downhill side.

Urban growth in present open spaces can have a more serious impact on ground water quality and quantity. Urban growth normally takes place in flat valley areas before moving on to the hills and ridges which are more expensive to build on. The valleys with deep alluvial soils are virtually the only recharge areas for the aquifers in the primarily sandstone coastal range including the hills surrounding Mt. Diablo. The effects of urban cover over the normally absorbent alluvial soils have been discussed earlier. This layer prevents precipitation and surface run-off from surrounding hills from reaching the porous subsurface levels. It is instead carried away to lower areas in storm sewers, frequently with urban pollutants and excessive sediments.

Associated with the recharge areas are two important functions which help maintain water quality and with which urbanization would interfere. First, the extensive, often sandy, recharge areas filter and help purify the water before reaching the aquifer zone. Secondly, in low lying areas next to Suisun Bay and the saline channels and bays of the San Joaquin River, the recharge areas normally maintain hydrostatic pressure, or "head", preventing salt water intrusion and deterioration of the aquifers. Such intrusion has already occurred in some areas due to excessive pumping and would be further encouraged by the covering over of the recharge zones.

2) Agricultural Resources: Soil and climatic conditions are very favorable to extensive agricultural use in many areas of the East and Central County. These areas, except those which are urban, have been assumed for this evaluation to represent a valuable resource. Two types of agriculture were defined: row crops, orchards and vineyards; and beef cattle and dairy ranches (grazing).

The extension lines in themselves do not represent extensive conflict with agricultural resources since they frequently are located in or adjacent to active railroad lines. Yards or stations may require excavation and removal of prime or other productive soils.

The far greater impacts occur as a result of BART caused land use changes. A change of ownership to residential and commercial use essentially obviates any agricultural use. The construction of standard roads and residential or commercial buildings removes or paves over the soil. Areas between buildings are traversed by underground utilities (sewer, water, gas and electrical), and transformed into gardens, also eliminating future possible agricultural use. Such irreversible impacts are not limited to the flat valleys of prime and other valuable soils but may extend as well into valuable and usable grazing lands in the hills.

Visual and Recreation Resources:
1) Visual Resources: There are extensive areas of open land within the PAX study bounds. Many of these areas provide important views and are significant environmental assets to most people now living, working, and recreating in the north, central and East County areas.

Three types of visually important open space lands have been defined. Visual corridors have been delineated for Marsh Creek Road, Deer Valley Road, Markley Canyon Road, Kirker Creek Road, Nortonville Road, and Waterfront Road. (2) With the exception of Marsh Creek Road, all have been listed in the County's proposed scenic route system as "rural scenic recreation routes". Secondly, slopes and ridges prominent from within existing communities were defined by random viewing from flat unobstructed areas nearby. In the third group are views from a prominent publicly accessible ridgetop in the recently acquired East Bay Regional Parks District Coal Mines Park.

BART structures in these designated visual resource areas intrude into the view. Where no freeway or rail line already exists, the assumption has been made that the value of these lands is primarily dependent upon their quality in an undeveloped state. New urban and suburban growth similarly intrudes into the view of prominent open lands.

2) Recreation-Education Resources: Existing and proposed recreation areas such as those proposed in the East Bay Regional Parks District Plan, lands designated as open space on public agency plans, and lands representing various open space interest group values have been defined as recreation-education resources. Existing state, regional, and local parks are included, as are proposals by the various agencies at different governmental levels. Open space plans have been prepared by ABAG and Contra Costa County and plans have been prepared or are in preparation by the cities in the corridor. Interest groups expressing their values range from those with statewide concern, such as the California Native Plant Society, to those with specific local concerns, such as Diablo Wheelman Bicycle Club.

The lands defined as being important for recreation and education purposes attain this value either as a result of their present undeveloped state, or some unique environmental feature. The physically disruptive impacts of the extension lines, either at-grade or aerial stations or yards and of new urban development would be in almost every instance in direct conflict with defined values. Of the four types of open space lands defined, physical disruption should be viewed as a more serious impact within existing or proposed parks or open lands as these sites are obviously designations of specific recreation interests.

Since many of the recreation-education values expressed are specifically concerned with using the open landscape in its present, essentially unurbanized state, noise intrusions could be a significant impact. The BART trains running at high speeds on-grade, and especially on elevated lines in the absence of adequate shielding, can produce noise which is detectable for a distance of two miles. In addition, new sources of noise associated with urban growth can produce similar adverse intrusions into the open space lands.

LEVEL OF TRANSPORTATION SERVICE

This category concerns the ability of route and station locations and design to attract ridership and the ability of the system to function as part of a balanced local and regional transportation network.

Travel Times: The evaluation of BART travel time required a study of how long it takes a BART passenger to get from stations serving different areas of the corridor to a common point on the existing BART system. Travel times were calculated on the basis of standard BART operating characteristics, including 80 mile per hour top speeds and standard acceleration/deceleration curves.

Schedule: Frequencies of service, both during peak hour and off-peak periods, were estimated for the extension alternatives. Headways for the alternatives of extending BART from the Concord Station have an estimated schedule based on 1-1/2 minute frequencies during peak service in downtown San Francisco.

Population Served: An evaluation of the population served by an extension alternative was used in lieu of a comparison of patronage. Since the Regional Transit Travel Projection Project tests were not completed at this state of the project.

The evaluation estimated future population within convenient walking distance and 5 minutes local driving distance of BART stations. To describe the population served by the extension alternatives, travel time isochrons for walking and driving travel times were computed for the extension stations. These were superimposed on the future population projected for the appropriate growth alternative to determine the population served. A 10-minute driving isochron was computed during these studies, but was not used because for every alternative, the area encompassed by a 10-minute drive covered most of the corridor.

Relationship to Other Transportation: General analyses were made of the relationship between extension alternatives and other transportation facilities in the corridor, including: improvements to SR-4, the potential for local community transit service within the corridor, and alternative inter-regional transportation improvements in the San Francisco, Sacramento, Stockton corridor.

RIGHT-OF-WAY, CONSTRUCTION AND TRANSIT OPERATIONS

Construction Cost: The cost required to design and construct each BART extension alternative was estimated based on construction methods and procedures utilized on similar work in this and other areas, especially the recent local experience in constructing BART. The costs were adjusted for localized construction problems such as grade separations, special crossings and other unusual features or site conditions.

Geometrics: BART geometric criteria were used in laying out the alternative extension alignments.

Transit Operations: Transit to the Pittsburg-Antioch area will be an extension of the existing Daly City-Concord BART line. The extension will have the limitations and capabilities of the existing BART system, as well as the requirements of the extension to Pittsburg-Antioch. Current BART operation plans provide for two-minute service into and out of San Francisco during peak hours for the foreseeable future. However, the ultimate capacity of the system is one and one half minute intervals or headways between trains based on system automatic train control design criteria. Train headways on the Daly City-Concord line are dictated by the headway schedule through the Trans-Bay Tube. For example, with two-minute transit service in San Francisco, there could be six-minute transit service provided on the Daly City-Concord line.

Train, Vehicle and Yard Requirements: These requirements were evaluated using criteria and estimates provided by the BARTD staff.

Section 3: Identification of Alternative Routes and Stations

While the task of developing criteria to be used for evaluating alternative extensions was still in progress, work began on the selection of various line and station locations. These alternative combinations of line segments and stations were studied on a section by section basis, the different geographical sections of the corridor being delineated according to the nature of this particular study. Though the desirability of each of these alternatives could not be determined until the guidelines of the Evaluation Criteria Report were available, it was possible for the Advisory Committees, the project staff, and other study participants to select a variety of line and station combinations which would merit consideration.

The initial identification of reasonable alternatives was presented in January, 1973, and was based upon issues described in an Issues Report prepared during Task 1, review of previous transportation studies for the corridor, field visits, review of City and County plans, and study of topographic maps and aerial photographs. For the alignment alternatives, consideration was given to the physical characteristics and capability of the transit system, and to possible community impacts. For stations, consideration was given to street and highway access and to the possible relationship of the station to commercial, industrial and residential areas.

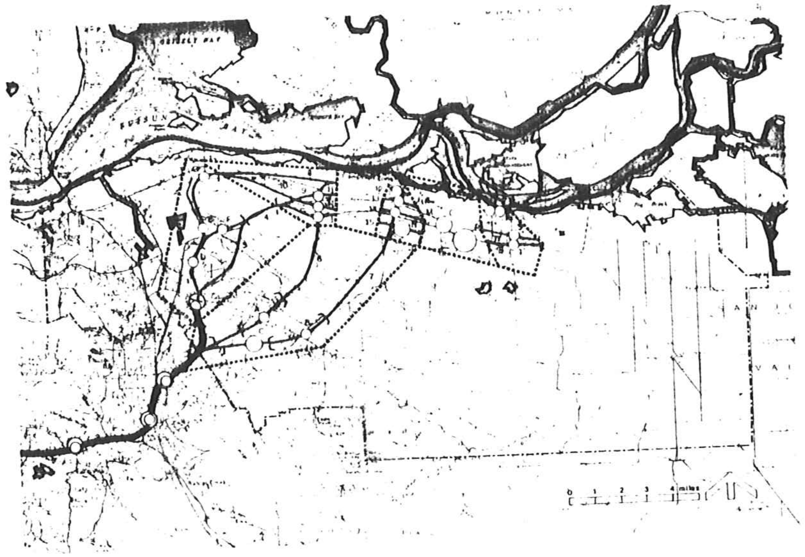


Figure 3-1. Initial Identification of Alternative Routes and

▪▪▪▪▪ Analysis Zone

Existing BART Concord Line

═ Route Segment

Subway

▬ Route Alternative

○ Station Alternative

Additional station and line alternatives were then introduced for evaluation by study participants during the Citizens' and Technical Advisory Committees' review. A more refined Identification Report was then published in March, with the exception that the Concord Boulevard line alternative was eliminated because it did not relate to an identifiable station alternative.

Station and line alternatives were described separately in the Identification Report, according to the areas of the corridor which they would serve and have impact upon. The general reasons for their consideration were also listed.

For the purposes of this study, eight distinct areas within the corridor were separately considered. They were delineated by existing communities, natural features (the hills and river and Delta) and non-urban portions. The station and route alternatives were catalogued according to these areas.

Between the communities of Concord, West Pittsburg, Pittsburg, and Antioch, subject to conformance to the operational limitations and characteristics of rail transit systems, the BART line can go almost anywhere without severe disruption to existing communities and transportation lines. These in between areas are called Transition Zones within which the BART line can maneuver to connect to stations in the areas described above.

BART extension stations and lines in the corridor areas and Transition Zones are shown in Figure 3-1. The descriptions of the stations and lines shown on the drawing and the specific reasons for their consideration have been included in this section. The basic qualifications which had to be met for initial selection are listed next before going into specific details.

STATION ALTERNATIVES

Each station alternative is designated by a letter and is located in the vicinity of the circle indicated in Figure 3-1. Generally, the reasons for considering stations fell into five categories:

- Conformity to local and regional plans - Stations which have been adopted by planning jurisdictions.
- Development/Redevelopment Potential - Stations which create the opportunity for accomplishing the development/redevelopment objectives expressed or implied by local and regional plans, citizens and interest groups.
- Access - Stations which have good potential automobile and bus access from surrounding communities, and/or good pedestrian accessibility to activity centers, such as shopping areas, schools, hospitals and government offices.
- Service - Stations which provide good service to activity centers and/or to existing or future residential development.
- Continuity - The feasibility of the station location in terms of line considerations on either side.

The negative impacts of the stations and lines upon the urban and natural environments, such as degradation to neighborhoods, wildlife habitats, agricultural resources and recreation uses, and conflicts with potential hazard areas (fault zones, flood zones, unstable soils, etc.) were not included in the alternatives identification process, since these would have constituted reasons to drop alternatives from consideration and not to propose them for evaluation.

The following sections contain station descriptions and reasons for consideration. They are sub-divided according to the various areas used for this part of the study.

CLAYTON VALLEY AREA

A. Bailey Road/Clayton Road Station: The area is a small commercial sub-center with convenience shopping for rapidly developing single-family subdivisions nearby. Clayton School is within walking distance of the station. Reasons for consideration include:

1) Automobile/bus access via Bailey Road and Clayton Road;
2) Service to community with substantial commuter population;
3) Development potential in conjunction with commercial center;
4) Continuity with Bailey Road line segment.

B1 Kirker Pass Road/Clayton Road Station: The area is a convenience shopping sub-center with adjacent vacant land in a single-family, middle-income community. Several schools are located in the vicinity. The Concord Performing Arts Center is being planned for a site east of Kirker Pass Road at Laurel Drive. Reasons for consideration include:

1) Automobile/bus access via Kirker Pass Road and Clayton Road;
2) Service to community with substantial commuter population and possibly to the Performing Arts Center;
3) Development potential in conjunction with sub-center, possible as alternative East Concord major activity center if location shown on Concord General Plan does not develop;
4) Continuity with Kirker Pass line segment.

B2 Clayton Station: Clayton is a community with a current population of approximately 1,500. The area is undergoing some single-family home development. The Clayton General Plan, although it indicates generally low density residential development, proposes a new town center and executive park. Reasons for consideration include:

1) Service to the proposed Clayton Town Center or Executive Park;
2) Service to a community with growing commuter population.

C. Ygnacio Valley Road/Bailey Road Connection Station: This area is being developed in single-family subdivisions. The Concord General Plan locates a major activity center in the vicinity; the area is a site for a future State College. A planned extension of Bailey Road from Clayton Road to Ygnacio Valley Road would improve access to the area. Reasons for consideration include:

1) Development potential in conjunction with activity center shown in Concord General Plan;
2) Automobile/bus access via Ygnacio Valley Road and future Bailey Road extensions; pedestrian and bus access to activity center and State College sites;
3) Service to developing residential area and major planned activities;
4) Continuity with Ygnacio Valley Road line segment.

NORTH CONCORD AREA

D. Port Chicago Highway/Olivera Road/Holbrook Dri. Station: The area is a small convenience shopping center; Glenbrook school is located close by. The surrounding single-family community is stable and well-defined by State Highway 4, Buchanan Field and U.S. Naval Weapons Station. The Navy is considering developing approximately 1,000 units of officers' housing in the vicinity. Reasons for consideration include:

1) Automobile/bus access via Port Chicago Highway and State Highway 4 from Martinez;
2) Service to North Concord and Martinez and future military housing;
3) Continuity with Port Chicago Highway line segment.

E. Port Chicago Highway/State Highway 4 Station: The area is adjacent to the Concord Municipal Golf Course and the weapons storage and headquarters areas of the U.S. Naval Weapons Station. The State intends to improve State Highway 4 to six and ultimately eight lanes through the area. Reasons for consideration include:

1) Automobile/express bus access via State Highway 4;
2) Continuity with Port Chicago Highway line segment.
3) Potential Industrial Park nearby.

F. State Highway 4/U.S. Naval Weapons Station: The area is the headquarters complex of the U.S. Naval Weapons Station and is shown in the Concord General Plan as the site of a future activity center including housing and related commercial and community facility use. Reasons for consideration include:

1) Development potential in conjunction with the future activity center and interim service to the headquarters complex;
2) Automobile/bus access via State Highway 4;
3) Continuity with State Highway 4 line segment.

G. Port Chicago Station: Port Chicago was purchased by the U.S. Navy to insure safety of weapons handling and is now essentially vacant except for Navy facilities, including deep water piers and rail lines. Reasons for consideration include:

1) Development potential in conjunction with a new community, major activity center, port, or regional recreational facility at such time as the Navy ceases operations in the area. (2)

WEST PITTSBURG AREA

H. Willow Pass Road/Bailey Road Station: The area is an older low income community with deteriorated housing and a strip of small businesses along Willow Pass Road. Reasons for consideration include:

1) Potential for redevelopment of sub-standard housing and marginal business in the area; potential for developing new housing or commercial activity on the Shell Tract;
2) Access along Willow Pass Road and Bailey Road; potential feeder bus connections to the refinery;
3) Service to the West Pittsburg community, the refinery and possible future industry;
4) Continuity with Willow Pass Road or Bailey Road line segments.

I. Aqueduct/Bailey Road Station: The area is an older low income community with deteriorated housing. Reasons for consideration include:

1) Redevelopment potential in conjunction with the opportunity to replace sub-standard housing and marginal business in the area; potential for developing new housing or commercial activity on the Shell Tract.
2) Access along Willow Pass Road and Bailey Road, potential feeder bus connections to the refinery;
3) Service to the West Pittsburg community, the refinery and possible future industry;
4) Continuity with Aqueduct or Bailey Road line segments.

J. Bailey Road/State Highway 4 Station: The area is an older low income community with deteriorated housing. The hills southeast of State Highway 4 are undeveloped. Blair School is located in the vicinity. Reasons for consideration include:

1) Automobile and express bus access via State Highway 4;
2) Partial service to West Pittsburg;
3) Continuity with State Highway 4 or Bailey Road line segments.

PITTSBURG AREA

K. SNRR/Los Medanos Street Station: The area is in the southern portion of downtown Pittsburg with older businesses, post office and church in the immediate vicinity and mixed older single-family homes and apartments to the east and west. Railroad Avenue is the main access route. Reasons for consideration include:

1) Redevelopment potential in conjunction with Pittsburg redevelopment projects and conformance with the General Plan objective of downtown revitalization;
2) Automobile/bus access via Railroad Avenue and possibly via Harbor Avenue, the improvement of which between State Highway 4 and downtown is now being studied by the city's Community Development

Department; pedestrian access to downtown and from surrounding residential areas;
3) Service to low income minority community;
4) Conformity with the Community Goals Document and general planning studies being conducted by the city as part of its plan revision;
5) Continuity with SNRR line segment.

L. SPRR/Railroad Avenue Station: The area is characterized by newer commercial uses mixed with apartments and older single-family homes and is several blocks south of the downtown. Pittsburg High School and a city park are in the vicinity. Reasons for consideration include:
1) Automobile/bus access via Railroad Avenue;
2) Continuity with SPTC or Kirker Pass line segments.

M. State Highway 4/Railroad Avenue Station: The Pittsburg Civic Center is to the north of State Highway 4. Newer commercial establishments are located along Railroad Avenue to the south, where single-family communities are under development. Camp Stoneman, an unused military camp, is nearby.
Reasons for consideration include:
1) Automobile/bus access via Railroad Avenue and State Highway 4; pedestrian access to Civic Center and potential future activity center on Camp Stoneman site;
2) Service to Civic Center, Camp Stoneman development and to new single-family communities developing south of State Highway 4;
3) Development potential in conjunction with future uses of Camp Stoneman;
4) Continuity with State Highway 4 or Kirker Pass line segments.

N. Aqueduct/Camp Stoneman Station: Newer commercial establishments are located along Railroad Avenue where single-family communities are under development. Camp Stoneman, an unused military camp, is nearby. Reasons for consideration include:
1) Development potential in conjunction with future use of Camp Stoneman;
2) Direct service to residential areas being developed south of State Highway 4;
3) Continuity with Aqueduct or Kirker Pass line segments.

AREA BETWEEN PITTSBURG AND ANTIOCH

O. Los Medanos College Station: The area is the site of Los Medanos Community College, and is surrounded by large undeveloped industrial ownerships. The U.S. Steel Mill is located to the northeast. Reasons for consideration include:
1) Development potential in conjunction with possible future college expansion and/or development of industrial land;
2) Automobile/bus access via State Highway 4 and Pittsburg-Antioch Highway; opportunity to separate access from local traffic;
3) Service to college and industrial or other type of development on vacant land; service via feeder to Pittsburg and Antioch.

4) Potential terminus, acting as common Stations for Pittsburg and Antioch.

P. County East Shopping Center Station: County East Shopping Center is continuing to expand and will soon include several major retail establishments. New single-family communities are developing in the vicinity and apartments are clustering around this activity center. Reasons for consideration include:
1) Development potential in conjunction with shopping center;
2) Automobile/bus access via State Highway 4 and Somersville Road; pedestrian access to activity center; potential bus feeder to station also serving activity center;
3) Service to developing subdivisions; service via feeder to Pittsburg and Antioch.

ANTIOCH AREA

Q. ATSF/L Street Station: The area is an older mixed single-family and apartment neighborhood, with some small businesses. The downtown area is immediately adjacent to the east. A cannery and the partially used Fibregoard plant are located to the west. Reasons for considerations include:
1) Redevelopment potential in conjunction with the revitalization of the area now under study by the city; possible reuse of the Fibreboard site; potential marina or recreational activities along Antioch waterfront.
2) Pedestrian/bus access to downtown activity center; automobile/bus access via Somersville Road and 4th Street.
3) Service to downtown Antioch and adjacent lower income community; service to potential marina;
4) Conformity to plans, although the city is currently revising its General Plan;
5) Continuity with ATSF line segment.

R. ATSF/G Street Station: The area lies between downtown Antioch and the waterfront at the foot of the main commercial street, two blocks from City Hall. Reasons for consideration include:
1) Same as for station at L Street (Q), except for closer pedestrian/bus access to downtown and the opportunity to connect downtown more directly with potential waterfront activities.

S. SP/A Street Station: The area is a shopping center with commercial establishments located along both sides of A Street, becoming strip commercial north of 18th. The community in the vicinity has predominantly older single-family homes with some newer apartments. Reasons for consideration include:
1) Redevelopment opportunity in conjunction with possible intensification of activity center;
2) Automobile/bus access along A Street from 18th Street and State Highway 4; pedestrian/bus access to shopping center;
3) Continuity with SPTC line segment.

T. State Highway 4/A Street Station: Newer single-family community with commercial establishments along Lone Tree Way. Reasons for consideration include:
1) Automobile/bus access via State Highway 4, A Street and Lone Tree Way;
2) Service to new communities developing south of State Highway 4 and to the east;
3) Continuity with State Highway 4 line segment.

EAST OF ANTIOCH AREA

U. Lone Tree Valley: The upper section of Lone Tree Valley is a wide flat area used today primarily for cattle grazing. The area is characterized by large property ownerships and land resource conditions suitable for residential development; it lies within the Antioch Planning Area and borders the recommended urban limit line under consideration. Reasons for consideration include:
1) Conformity to the 1956 San Francisco Bay Area Rapid Transit Commission Report, which showed a rapid transit extension beyond Antioch.
2) Development potential with regard to an area which has land resource and ownership characteristics which are more suitable for residential development than other areas south and east of Antioch.

LINE ALTERNATIVES

Each line alternative was designated by a number as is indicated in Figure 3-1. The limits of each numbered segment were established between those locations where potential lines had a common point or at the boundaries of one of the various delineated corridor areas:

In general, the reasons for considering the line segments fell into the following categories:

- Conformity to local and regional plans.
- Conformity to station sites.
- Conformity to operational characteristics of rail transit systems.
- Reasonable construction costs.

In the following sections the line alternatives are described generally by segment according to major areas of the corridor, and reasons are given for their consideration. To provide more detail about each individual line, Table 3-1 has been included in which each line has been subdivided with an indication of the various profiles or construction types that occur within each segment.

Two transition zones have been

identified within which exist numerous line alternatives which can link adjacent line or station alternatives. For example, four routes are possible to connect line segment 8 in West Pittsburg with line segments 12, 13, 14, and 15 in Pittsburg. Routes within transition zones were identified and evaluated after station alternatives adjacent to or within the zones were selected for further study.

NORTH CONCORD AREA

Line 1 - Port Chicago Highway: Leaving the Concord BART Station, the line follows Port Chicago Highway to a point near Panoramic Drive just south of State Highway 4. Reasons for consideration include:

1) Sacramento Northern Railroad right-of-way is available to a point just north of State Highway 4.
2) Use of RR right-of-way causes minimal disruption to community.
3) Station located at Olivera Road.

Line 2 - Port Chicago Highway: This line is a continuation of Line 1 from Panoramic Drive and follows Port Chicago Highway, past State Highway 4 and Port Chicago where the Mokelumne Aqueduct lies adjacent to the Port Chicago Highway. Reasons for consideration include:

1) The hills between Concord and West Pittsburg do not have to be negotiated.
2) A station could be located at State Highway 4 and Port Chicago Highway.

Line 3 - State Highway 4: From Panoramic Drive on Port Chicago Highway (north end of Line 1) the line curves and follows State Highway 4 to a point where Willow Pass Road in North Concord intersects State Highway 4. Reasons for consideration include:

1) Provides joint use transportation corridor with highways;
2) An improved State Highway 4, as planned by the California Department of Transportation, will provide an easy means of negotiating the hills between Concord and West Pittsburg;
3) Station located in U.S. Naval Weapons Station.

Line 4 - State Highway 4: This line segment follows State Highway 4 between the western intersection with Willow Pass Road and the eastern intersection with the same road. Reasons for consideration include:

1) Provides joint use transportation corridor with highways.

Line 5 - Willow Pass Road: This line leaves the Concord Station and follows Willow Pass Road until it meets State Highway 4 near the northern boundary of the U.S. Naval Weapons Station. For reasons of safety, the line through the Weapons Station is restricted to the Willow Pass Road right-of-way. Reasons for consideration include:

1) Shortest route between the Concord Station and Willow Pass.

CLAYTON VALLEY PORTION

Line 6 - Bailey Road: This line leaves the existing BART line at Oak Grove Road, south of the existing BART station, in Concord and tunnels through Lime Ridge to Cowell Road. From Cowell Road the line goes northeast to Bailey Road and then tunnels through the hills in an alignment which follows Bailey Road into West Pittsburg. For reasons of safety, the line through the U.S. Naval Weapons Station is restricted to the Bailey Road rights-of-way. Reasons for consideration include:

1) Station at Bailey Pass Road/ Clayton Road;
2) Provides possible stations in West Pittsburg.
3) More direct service between Pittsburg and Concord.

Line 7 - Kirker Pass Road: This line leaves the existing BART line at Oak Grove Road south of the existing BART station in Concord and tunnels through Lime Ridge to a point near the intersection of Cowell Road and Ygnacio Valley Road. The line generally follows Ygnacio Valley Road and then tunnels through the hills in an alignment which generally follows Kirker Pass Road into Pittsburg. Reasons for consideration include:

1) Stations at Kirker Pass/Clayton Road, Ygnacio Valley Road at the proposed State College site, and in the vicinity of downtown Clayton;
2) Shortest tunnel route to negotiate the hills lying between Clayton and Pittsburg.

WEST PITTSBURG AREA

Line 8 - Port Chicago Highway/ SNRR: This line starts at the point where the Mokelumne Aqueduct is adjacent to Port Chicago Highway (north end of Line 2). The line follows Port Chicago Highway to McAvoy Street in Shore Acres, at which point it heads east across the tidelands towards the SNRR corridor in Pittsburg. This line terminates near West Pittsburg, at a point in line with Loftus Road in West Pittsburg. Reasons for consideration include:

1) Shortest route connecting a line along Port Chicago Highway to a line along the SNRR right-of-way in Pittsburg;
2) The ground elevation does not vary significantly along the tidelands.

Table 3-1. Alternative Line Descriptions

Line	Segment		Profil	
	From	To	A	G
1	Concord Station	Panoramic Drive	X	X
2	Panoramic Drive	Kilburn Street	X	X
	Kilburn Street	Port Chicago Hwy.	X	X
3	Panoramic Drive	Willow Pass Road (Concord)	X	X
4	Willow Pass Road (Concord)	Willow Pass Road (West Pittsburg)		X
5	Concord Station	Lynwood Drive	X	
	Lynwood Drive	State Highway 4		
6	Oak Grove Road	Contra Costa Canal	X	
	Contra Costa Canal	Cowell Road		
	Cowell Road	Clayton Road	X	
	Clayton Road	Lincoln Drive	X	
	Lincoln Drive	West Pittsburg		
7	Oak Grove Road	Contra Costa Canal	X	
	Contra Costa Canal	Cowell Road		
	Cowell Road	Clayton Road	X	
	Clayton Road	Myrtle Drive	X	
	Myrtle Drive	Pittsburg		
8	Port Chicago	Wharf Drive		
	Wharf Drive	Loftus Road	X	X
9	State Hwy. 4	Port Chicago Hwy.	X	
	Port Chicago Hwy.	Loftus Road	X	
10	Port Chicago Hwy.	Wharf Drive		
	Wharf Drive	Willow Pass Road	X	X
	Willow Pass Road	Loftus Road	X	
11	Willow Pass Road	Loftus Road	X	X
12	Montezuma Street	Harbor Street	X	
13	Warren Way	Columbia Street	X	X
14	Burton Street	Loveridge Road	X	X
15	Burton Street	Loveridge Road	X	
16	"O" Street	"A" Street	X	X
17	"O" Street	Hillcrest Avenue	X	X
18	Contra Loma Blvd.	Hillcrest Avenue	X	X

A = Aerial
G = At-grade
S = Subway
(T) = Tunneled Subway

These designations describe various types of profile or construction occur within the segments of the individual lines shown in Figure 3-1

Line 9 - Willow Pass Road: This line starts at a point just west of West Pittsburg where Willow Pass Road and State Highway 4 separate (east end of Line 4). The line follows Willow Pass Road through West Pittsburg to Loftus Road. Reasons for consideration include:
1) Station at Bailey Road.

Line 10 - Mokelumne Aqueduct: This line starts at the point where the Mokelumne Aqueduct is adjacent to Port Chicago Highway (north end of Line 2). The line follows the Mokelumne Aqueduct to the vicinity of Loftus Road in West Pittsburg. Reasons for consideration include:
1) The aqueduct right-of-way provides a natural corridor through West Pittsburg;
2) The ground elevation does not vary significantly along the aqueduct;
3) The aqueduct has a 100' right-of-way which could be utilized to aid in reducing the impacts of transit (noise, visual, etc.) on one side of the line;
4) Station at Bailey Road.

Line 11 - State Highway 4: This line starts at the east end of Line 4 and follows Highway 4 to the vicinity of Loftus Road. Reasons for consideration include:
1) Station located at Bailey Road;
2) Provides joint use transportation corridor with highway.

TRANSITION ZONE - PITTSBURG AREA

Line 12 - Sacramento Northern Railroad: This line follows the SNRR line through Pittsburg from Montezuma Street on the west side to Harbor Street on the east side. Reasons for consideration include:
1) Downtown Pittsburg station located at Los Medanos Street;
2) SNRR right-of-way could be made available;
3) Minimizes community disruption.

Line 13 - Southern Pacific Railroad: This line follows the Southern Pacific Railroad through Pittsburg, from Warren Way on the west side to Columbia Street on the east side. Reasons for consideration include:
1) Station location at Railroad Avenue;
2) Joint use railroad corridor;
3) Minimized community disruption.

Line 14 - State Highway 4: This line follows State Highway 4 through Pittsburg, from Burton Street on the west side of Loveridge Road on the east side. Reasons for consideration include:
1) Station location at Railroad Avenue;
2) Provides joint use transportation corridor with highways.

Line 15 - Mokelumne Aqueduct: This line follows the Mokelumne Aqueduct through Pittsburg, from Burton Street on the west side to Loveridge Road on the east side. Reasons for consideration include:
1) Station located east of Railroad Avenue;
2) The ground elevation does not vary significantly along the aqueduct;
3) The aqueduct has a 100' right-of-way which could be utilized to aid in reducing impacts of transit on one side of the line.

TRANSITION ZONES - ANTIOCH AREA

Line 16 - Santa Fe Railroad: This line follows the Atchison, Topeka and Santa Fe Railroad through Antioch, from "O" Street on the west side to an extension of "A" Street on the east side. Reasons for consideration include:
1) Stations located at "L" and "G" Streets;
2) Joint use railroad corridor;
3) Minimized community disruption.

Line 17 - Southern Pacific RR: This line follows the Southern Pacific Railroad through Antioch, from about "O" Street on the west side to Hillcrest Avenue on the east side. Reasons for consideration include:
1) Station located at "A" Street;
2) Joint use railroad corridor;
3) Minimize community disruption.

Line 18 - State Highway 4: This line follows State Highway 4 through Antioch, from about Contra Loma Boulevard on the west side to Hillcrest Avenue on the east side. Reasons for consideration include:
1) Station located at "A" Street;
2) Provides joint use transportation corridor with highways.

Section 4: Evaluation and Selection of Routes and Stations

The evaluation process which resulted in the eventual selection of a recommended extension alignment, was accomplished in four phases. The first phase involved combining the many line segments and stations into complete extension route alternatives for evaluation and review. This was done to determine how well alternatives represented major corridor growth and BART service options, conflicts between corridor and local objectives and overall feasibility. The source of these alternative line segments and stations was the section by section analysis covered in the report entitled "Identification of Route and Station Alternatives" and which is discussed in Section 3. The second phase consisted of evaluating all the alternative extensions and selecting two routes for detailed evaluation. This involved eliminating some routes and modifying or combining others in order to finally arrive at two acceptable alternatives which represented different futures for the corridor. The third phase involved detailed evaluation of the two alternatives and led to the selection of a single route and station set for conceptual extension design. During the fourth and final phase, a detailed impact analysis of the recommended line and stations was made together with a comparison of the selected extension with the "no transit" alternative. The efforts and results of the first three phases are discussed in this section, while the work of the fourth phase is described in Sections 5 and 10.

ALTERNATIVE EXTENSION SELECTION

The alternative stations and line segments identified in the "Identification of Route and Station Alternatives Report" were the building blocks for the Pittsburg-Antioch BART Extension. These stations and line segments could have been assembled in a multitude of different ways to produce innumerable extension routes and station alternatives. However, if this had been done, many of the alternative routes would have been similar or would have overlapped. Therefore, the first step in the evaluation process was to sort out the line and station alternatives according to basic categories of acceptable growth patterns and levels of transportation service. This made possible the selection of a representative set of routes for evaluation.

Before, the study team could assign a particular growth assumption to any section of any extension, it was first necessary to analyse existing corridor characteristics and trends. Having done this, it was possible to determine which growth alternatives would be acceptable and possible for the various subareas.

CORRIDOR CHARACTERISTICS AND TRENDS

The project studied factors determining growth trends in the corridor and projected trend growth to 1990. Trend growth is substantially determined by today's corridor characteristics, the inertia of current public programs and governmental regulations, private property interests, land resource characteristics and people's established attitudes toward their community and environment.

The communities served by the proposed extension presently exhibit widely differing characteristics and levels of development. They range, briefly from the largest, Concord, with a very rapidly growing commuter population, increasing land and housing costs and some local employment growth, to the rural agricultural area of Brentwood and Oakley with very small urban areas, some limited sub-urbanization and mainly local employment.

In Concord, where the supply of flat or relatively level land is almost exhausted, there is pressure for hillside development and a strong movement toward garden apartments and townhouse construction. In Brentwood, a flat, fertile agricultural area such as Concord once was, economic factors in the agricultural business as well as pressure for rural residential development are threatening the area's future for crop growing. Without a comprehensive effort to protect agriculture, the area could become a site of substantial new urban growth.

Between these extremes are West Pittsburg, a spread, underdeveloped, suburban area, which provides housing for corridor industrial workers with jobs in Pittsburg and Antioch.

The following discussion illustrates some significant characteristics of the corridor communities and points up some of the contrasts. The backup for certain statements and statistics quoted below and related to population growth, housing, and socio-economic factors is the 1970 U.S. Census.

Concord: Concord is a varied community in terms of age and income levels. The central area and surrounding residential areas were built mainly during the 1950's when the City's most rapid growth took place. Newer subdivisions of the 1960's have shifted the center of the community eastwards away from the downtown area. The early 1970's have seen an accentuation of that trend and a growth rate faster than the City's average for the 1960's.

The two central area tracts contain a very high percentage of elderly persons. The income level and housing values are correspondingly low in this area. Elsewhere in both Concord and in other tracts around the center, housing prices reflect the age of the housing stock and attract families moving to Concord as a first stop before moving on to newer areas.

The majority of the higher value areas in the City are to the east of Bailey Road and vary from rural, large lot development to higher density apartments and condominia.

Two major new developments are taking place which will add substantially to the City's population and may be an indication of future trends. These are the pedestrian oriented single family development of some eight hundred and seventy units north of Ygnacio Valley Road and east of Cowell Road, and the more conventional subdivision of over eight hundred units on the Bernstein ranch at Kirker Pass Road and Concord Boulevard.

The development pattern of the City has been dictated mainly by topography with a resulting focus of radial routes upon the downtown. Development in the Clayton Valley is reinforcing the Concord Boulevard-Clayton Road axis. However, possible residential development south of Ygnacio Valley Road and encouragement of some type of activity center on the State College site, together with commercial development at Kirker Pass Road and Clayton Road and in central Clayton, could combine to weaken the central role of Concord's downtown.

The downtown area has already lost its significance as a retail center due to competition from Sun

Valley Mall, although Sun Valley makes Concord the strongest regional retail center in the County. City planning policy aims to intensify land use between the two areas and to redevelop or remodel downtown Concord to accommodate uses such as offices and apartments, creating an elongated core.

The different nature of the newly developed parts of east Concord and Clayton is demonstrated by their low percentage of low and moderate cost owner occupied housing, high median family income, high percentage of white collar workers, high number of automobiles per household and the very high family size.

Many of these characteristics would be reinforced if development of additional large acreages to the east and to the south were to take place. However, proposed County open space policies and a growing reaction against higher densities and further freeway construction make further major growth uncertain.

Pittsburg Pittsburg is one of the oldest communities in Contra Costa County. Pittsburg began as a residential and shipping base for the coal mines in the hills to the south, later developing fishing and, later still, basic industries as the coal was worked out.

Much of Pittsburg's population growth resulted from its industrial growth and, during the Second World War, from the establishment of Camp Stoneman and war-related industries. Some 21 percent of the City's residents are Spanish speaking, the descendents of Mexicans recruited to work in the steel mills, and 27 percent are Blacks, the majority of whom came to the City during World War II. With the closing of Camp Stoneman after the Korean War, an economic downturn began which has continued, accentuated by the age of much of the area's basic industries. Closing, relocation or modernization and automation of of local industrial plants all have diminished the supply of industrial jobs in the area. The majority of the City's residents are blue collar workers, many of them unskilled or semi-skilled, making for limited employment flexibility. Unemployment in the oldest section of the city, which includes the downtown and the waterfront, was 21.5 percent in 1970. The percentage for the City as a whole was 11.2 percent, over twice the rate for the County. The rate would be higher but for the high percentage of elderly residents in the area, which limits the size of the labor force. In addition, perhaps 25 percent of the labor force was estimated by the U.S. Department of Labor to be under-employed in 1970.

Accompanying the high level of unemployment in downtown Pittsburg is a rate of family poverty three times that of the corridor as a whole, and very limited mobility in an automobile-dependent employment situation. The difficulty of traveling to jobs is one aspect of the growing isolation of the downtown section of Pittsburg. The majority of the housing and commercial structures are very old and dilapidated or deteriorating. New housing south of SR-4 and easy access via the freeway to new commercial centers has led to the increasing polarization of these two parts of the community and to a consistent decline in retail sales since 1960.

Efforts to revitalize downtown Pittsburg, to ameliorate living conditions and to unify the community include a successful Model Cities Program, the demolition of sections of the commercial district by the City's Redevelopment Agency in anticipation of redevelopment, the proposed development of a large marina and encouragement of new industrial development to take advantage of available land at low cost and rail and freeway transportation.

The City's low land costs have been a major factor in making it attractive as a new residential area. Further development of single family density to both east and west of the City will be facilitated by the provision of services to these areas. Demand for additional higher value development in the hills can be anticipated to follow these developments, particularly with improved freeway access.

Antioch While Antioch's history has been similar to that of Pittsburg, its economic problems have been less severe. Some of its larger industries are newer than those of Pittsburg and are within the City's boundaries. It has a very small Black population and a comparatively low Spanish speaking population. A high proportion of the population in all census tracts are high school graduates, giving an employment flexibility lacking in older Pittsburg. Nevertheless some adjustments in the industrial base of the City can be anticipated and will have some impact on its economy.

The number of housing units in Antioch which were built before 1939 is similar to that in Pittsburg, but in general the housing stock is in better condition. Much of the housing in the older part of the City is rented and is an important resource for the elderly and for young families. The density of this area, however, is rather low by comparison with the older area of Concord.

The center of Antioch has been shifting away from downtown as subdivisions have been developed during the Sixties to the east and south and, in particular, to the southwest. There, the rapid suburban growth and relatively inexpensive housing is reflected by a percentage of the population under five years old, which is the highest of any census tract in the corridor, 13.9 percent.

In this southwestern area the County-East Regional Shopping Center has recently been completed south of SR-4. Its low density layout reflects the automobile orientation of the newer parts of the City. This center and the convenience center at 18th and "A" Streets are now regarded as the City's retail centers by the majority of the population, despite significant improvements to the old downtown by the downtown merchants.

As the large tracts of flat land have been developed, there has been an increasing trend towards hill development to the south where, while land costs are lower, construction costs are higher. The value of most housing in these areas is significantly higher than on the flat land. While the residents of the new subdivisions are still generally dependent upon local employment, it is likely that the percentage of out commuters is now significantly higher than the 1970 figure of 8.7 percent. In the southernmost census tract in the City, 25 percent of workers commuted out to jobs in 1970 and the median income in this tract was similar to that in East Concord.

West Pittsburg West Pittsburg is an unincorporated community which originated as a summer home subdivision, over 26 percent of the homes in the largest tract dating from before 1939. Later subdivisions of the 1940's and 1950's now provide generally well maintained single family houses and pleasant tree-lined streets. This sub-area offers one of the County's largest stocks of low and moderate cost housing in relatively good condition and includes two new large subdivision under construction, with houses costing under $20,000. The medi value in the largest tract is $16,000, compared with $25,700 for the County as a whole.

The area of flat land is relatively constricted, especially toward the west to the boundary of the U.S. Naval Weapons Station. However, additional subdivisions can be expected to fill in the area between West Pittsburg and Pittsburg. Demand for housing in the hills is unlikely for the foreseeable future in view of the availability of hillside subdivisions in Concord, Clayton and Antioch. However, fairly substantial acreage in West Pittsburg is either vacant or under-utilized and the community's commercial facilities are spread along Willow Pass Road in a scattered and often poorly maintained strip.

West Pittsburg houses predominantly blue collar families with a relatively large number of children under five years old, one of the lowest median family incomes, and one of the largest percentages of families below the 1970 poverty level in the County reflecting a rather high level of unemployment.

Brentwood The area to the east of Antioch has traditionally been one of the most significant agricultural resources of the Bay Area, with 32,000 acres of mostly prime soil. Raising predominatly fruit crops, the value of its produce has been high. In recent years, however, aging orchards, pests and soils in need of rejuvenation have contributed to diminished yields. Competition with larger producers in more recently cultivated areas

Table 4-1. Corridor Growth Alternative Comparisons: 1970 - 1990

		Trend		Concentrated		Accelerated	
	1970	1990	% Change*	1990	% Change*	1990	% Change*
Population	211, 266	355, 050	68.1	372, 930	76.5	468, 070	121.6
Households	62, 073	112, 620	81.4	120, 140	93.5	148, 050	138.5
Persons Per Household	3.4	3.15		3.1		3.1	
Mean Household Income	$ 11, 141	$ 13, 900	24.8	$14, 700	31.9	$ 15, 800	41.8
Single Family Units	51, 520	79, 940	55.2	73, 390	42.2	105, 370	104.5
Multiple Family Units	10, 553	33, 680	219.2	46, 750	343.0	42, 680	304.4
Retail Expenditures by Residents (1)	406.4	944.7	134.0	1, 034.8	156.3	1, 306.6	223.8
1970 Retail Sales (1)		460.4	-	460.4	-	460.4	-
New Potential (1)		484.3		574.4		846.2	
Warranted Retail Sq. Ft. @ $92 (2)		10, 268.5	56.1	11, 247.8	71.0	14, 202.2	115.9
1970 Retail Square Feet (2)		6, 577.8	-	6, 577.8	-	6, 577.8	-
Warranted Additional Retail Square Feet (2)		3, 690.7		4, 670.0		7, 624.4	
Resident Labor Force	82, 240	146, 830	78.5	153, 680	86.9	192, 240	133.8
Unemployed	4, 897	8, 440	72.4	9, 310	90.1	11, 030	125.2
% Unemployed	5.9	5.7		6		5.7	
Employed Residents	77, 343	138, 390	78.5	144, 370	86.7	181, 210	134.3
White Collar	39, 007	81, 490	108.9	85, 030	118.0	111, 110	184.8
Blue Collar	38, 336	56, 900	48.4	59, 340	54.8	70, 100	82.9
Net Out-Commuters	18, 038	56, 270	212.0	55, 000	204.9	80, 250	344.9
Out-Commuters % of Empl. Residents	23.3	40.7		38.1		44.4	
Jobs in Corridor	59, 305	82, 120	38.5	89, 370	50.7	100, 960	70.2
Agriculture & Mining	2, 077	1, 700	-18.2	1, 820	-12.4	1, 490	- 28.3
Construction	4, 964	4, 080	-17.8	3, 810	-23.2	4, 820	- 2.9
Manufacturing	13, 674	17, 150	25.4	20, 140	47.3	20, 130	47.2
TCU & SS (1)*	3, 782	5, 240	38.6	5, 870	55.2	6, 230	64.7
Wholesale Trade	1, 198	1, 780	48.6	2, 070	72.8	2, 540	112.0
Retail Trade	10, 867	13, 830	27.3	14, 820	36.4	16, 920	55.7
FIRE (2)*	1, 749	2, 490	42.4	2, 650	51.5	2, 970	69.8
Services	8, 203	14, 760	79.9	15, 540	89.4	19, 290	135.2
Public & Education	11, 421	17, 980	57.4	19, 420	70.0	22, 860	100.2
Other	1, 370	3, 120	127.7	3, 230	135.8	3, 710	170.8
Land Absorbed by Urbanization (in Acres)							
	Existing**						
Commercial	1, 307.5	282		253		637	
Service	540.6	180		166		400	
Wholesaling/Whsing	507.4	86		84		339	
Industrial	5, 510.3	541		992		1, 641	
FIRE (1)*	42.5	16		18		27	
Public Admin. & Education	6, 236.5	1, 580		1, 856		3, 702	
Total	14, 143.8	2, 685	19.0	3, 369	23, 8	6, 747	47.7

*From 1970
(1) Millions of 1970 dollars.
(2) Thousands of square feet

** Contra Costa County Land Use and Transportation Study.
(1)* Transportation, Communication, Utilities and Sanitary Services.
(2)* Finance, Insurance & Real Estate.

with longer growing seasons, predominatly in the Central Valley, has contributed to the area's economic problems. Division of the land into smaller parcels to augment farm incomes has created a pattern in much of the area which is unsuitable for many forms of agriculture and which has raised land values, putting an additional burden on farmers.

There is a high level of poverty among the families in the area, a reflection to a great extent of agricultural worker wages. Also, the median family income is among the lowest in the County. Contra Costa County Planning Department policy favors retention of the predominantly agricultural use of the area and through a planning program now underway is seeking means of protecting it from further fragmentation and major residential and recreational developments. In addition to the value of its agricultural soils, development of the area would be expensive in terms of providing services to protect future residents from such problems as flooding and water pollution.

TREND GROWTH FUTURE

The predicted results of trend growth in terms of the areas of the corridor which will be urbanized in 1990 are shown in Figure 4-1. Urban expansion will absorb approximately 3900 acres of open and grazing land into the hills east of Concord, south of Pittsburg-Antioch, and south of Martinez. An additional 4500 acres of agricultural land in East County will be absorbed.

Most of this acreage will be used for low density suburban subdivision and large-lot homes, although industry in the corridor will absorb about 550 acres and commerce an additional 550 acres.

To quantify the impacts of trend

growth on existing land use and to record the related general demographic changes predicted to occur, the following sections have been included. Table 4-1 has been included to compare the changes brought about by trend growth with the other corridor growth alternatives. An Extension-Growth Alternatives Memorandum (May 2, 1973) described the data used for preparation of the values in this table.

Housing: About 50,000 new suburban homes will be built in the corridor. Homes selling for $30,000 to $70,000 in 1973 dollars will extend into the gentler hills east of Concord and bordering Clayton Valley.

Substantial portions of the hills in southern Martinez will be used for similar communities. Less expensive subdivisions will fill the flat plains south of Pittsburg and Antioch extending into the lower hills. The gradual deterioration of the central areas of Pittsburg, Antioch and Concord will provide low-cost housing, much of it substandard, except where renewal programs and replacement of older homes by apartments occurs. In East County, moderately priced subdivision homes will be built in areas served by the Oakley and Brentwood sewer and water systems. Scattered large-lot homes will be built in the surrounding area.

The number of apartments will roughly triple, mostly in apartment complexes constructed on small parcels in urban areas, although some cluster apartment and townhouse communities will locate in eastern Concord and southern Martinez.

Population: About 350,000 people will live in the corridor, 140,000 more people than in 1970. Good suburban home buys near to the recreational opportunities of the Delta and rolling rural land will attract many moderate to upper income families. Attractive rental values will also bring many young families and others who cannot yet afford to purchase their homes. Blue collar workers and the unemployed will make up a sizeable low-income population in the older areas of Pittsburg and Antioch, north of SR-4. The corridor will also attract retired persons and others with substantial leisure time because of the proximity to the Delta. It is likely that separation between these segments of the corridor population will widen, unless fair housing laws and other programs are able to change people's attitudes toward housing location.

Employment: There will be about 80,000 jobs in the corridor, mostly in a population serving activities, such as retail trade, services, education and government. Employment in manufacturing and other industrial trades will increase moderately, while agricultural employment will decrease due to the disappearance of farming in East County. There will be about 50,000 too few jobs in the corridor for workers living in the area and the types of jobs will not match the skills of the resident labor force. About 80,000 white collar workers will live in the corridor, mostly in newer suburban areas, far exceeding the number of white collar jobs. Unemployment is expected to be about 6 percent for the corridor as a whole, although larger concentrations of unemployed workers will continue to be located in low-cost housing areas of Pittsburg and Antioch.

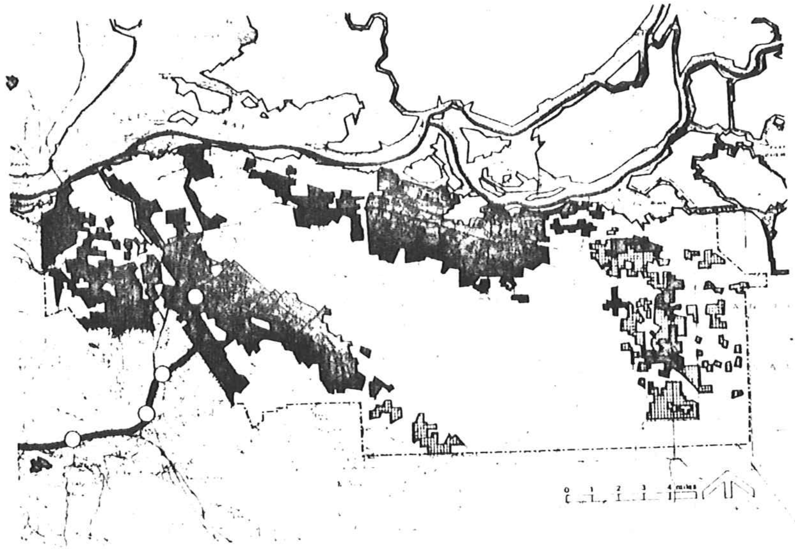


Figure 4-1. Trend Growth 1990

■ Potential Urban Area

▥ Scattered Development

Commerce: A substantial growth of population in the corridor, and increased average income will result in a potential market for area goods and services of about 940 million dollars in annual sales (in 1970 dollars). This market is likely to be served in the Concord area with an expanded downtown Concord-Sun Valley Mall complex and a new medium size shopping center. Pittsburg-Antioch area expenditures will support some expansion of County East and another comparable shopping center in the East County. Sales in downtown Pittsburg and Antioch will continue to decline, unless a concerted effort is made to revitalize downtown business areas. Industry in the area bordering Suisun Bay and the San Joaquin River will gradually increase through a process of plant expansion and intensified use of land presently zoned for industrial development. Major office development in Walnut Creek will preclude much office decentralization into the corridor. Also, based on the recently completed Central Concord Redevelopment Plan, a substantial increase in office development could occur in downtown Concord.

Agriculture: Agriculture in the East County will decline substantially as increased property taxes coupled with reduced yields continue to make small farms and cultivation of poorer soils unprofitable. A substantial acreage now being farmed is owned by individuals or firms as an investment in future development and will be sold and urbanized. Grazing in the hills closer to urban areas will decline when cattlemen are unable to sustain loss due to increasing costs, brush fires, dog packs, and trail bike riding.

Recreation: The Delta will be used intensively for recreation. Houseboats and trailered powerboats will make up most of the craft plying Delta waterways. There will be a substantial market for marina mooring and launch facilities. Acquisition of additional parks by the East Bay Regional Parks District and increased population in the area will result in more intensive recreational use of the hills.

Transportation: The increased population will require more local and regional transportation. Corridor jobs will be insufficient and of the wrong kind for many area residents, resulting in nearly half of the labor force commuting elsewhere to work. Within the corridor, an average family will take about nine trips a day to school, shopping, and for other purposes. New arterial streets will be built south of SR-4 in Pittsburg, Antioch and in East Concord. The street pattern within suburban subdivisions will be difficult to serve by local public transportation and, for local travel, people will continue to rely on the automobile.

SR-4 will be widened to an eight-lane freeway from I-680 to a new Antioch Bridge and various interchanges in the Pittsburg and Antioc area will either be improved or added. An express bus route will connect Brentwood, Antioch, Pittsburg, and Martinez with the Concord BART Station. This express service, along with other planned routes in the Concord and Martinez areas will provide some local bus service.

The scope for altering the future of the corridor substantially is limited because many of the changes which will occur between now and 1990 have already been committed.

- More than half of the housing which will be built during the period has already been planned, and has the required governmental approvals, financing and, sites.
- Most future commercial and industrial growth will be located according to existing zoning within the corridor.
- Capital improvement programs for new streets and urban services already anticipate where development will occur.
- A substantial portion of vacant land in the corridor is privately owned as an investment in future development. The location and size of these ownerships substantially determine the location and characteristics of the development plans which will be submitted to local governments for approval.
- Other factors, such as existing plans and policies of governments in the area, as well as the effects of taxation, already substantially commit the present direction of change.

ALTERNATIVE FUTURES

Despite this substantial commitment to the continuation of trends, with a BART extension,two basically different alternative futures are possible for the corridor.

1) A BART extension along with today's governmental land use controls and public investment policies will result in accelerated growth, which has similar characteristics to the trend. This alternative future is described in Figure 4-2.

2) A BART extension provides the opportunity to achieve public plans and policies now being formulated for establishing controlled or concentrated corridor growth. This corridor future is described in Figure 4-3. It locates BART extension stations where activity centers and higher density residential areas can be clustered close by. Firm land use controls and limits to urban service areas will be necessary to redirect growth into existing urban areas. These controls include the urban limit lines now under consideration by Contra Costa County, the open space and conservation elements of the County, Concord, Martinez, Pittsburg, Antioch and Brentwood General Plans, restrictions on building permits in areas not served by public facilities, and policies regulating development in areas with land resource hazards. As public redevelopment programs and private investment redirect growth, existing communities will be redesigned to provide smaller scale shopping and community facilities within residential areas. Walking, biking and local transit will be emphasized, rather than automobile circulation. Higher density living will be balanced by more community open space. This future will preserve existing land which is presently in open space or agricultural use.

Therefore, three major corridor growth alternatives were considered in determining the scope for using a BART extension as a growth-shaping tool.

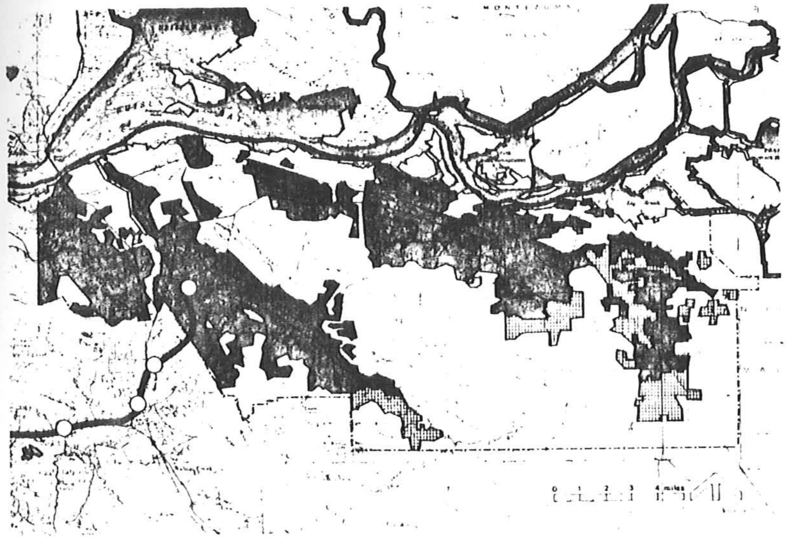


Figure 4-2. Accelerated Growth 1990

■ Potential Urban Area

▨ Scattered Development

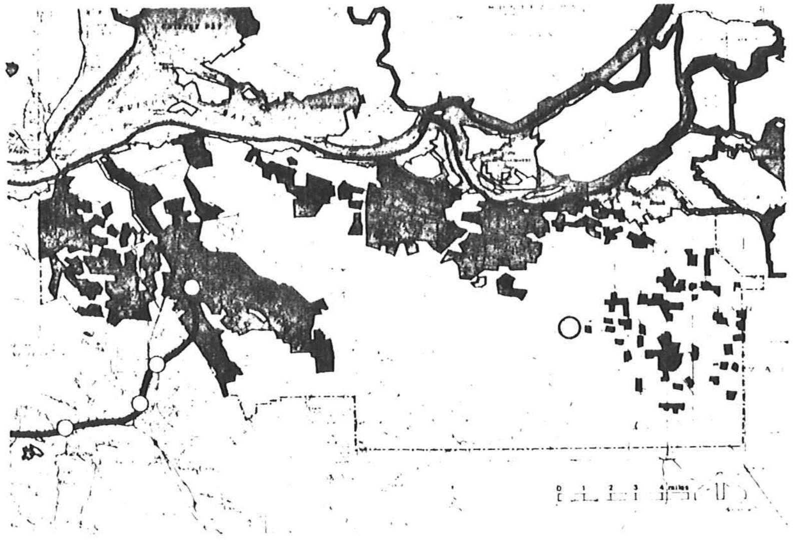


Figure 4-3. Concentrated Growth 1990

■ Potential Urban Area

○ New Town

PRE-BART CONTROLS

Growth in the corridor has already been stimulated to some extent by the BART Concord line. The Concord area has developed during the last ten years at a rate roughly twice that for the remainder of Contra Costa County and advertisements for new homes in the Pittsburg-Antioch area stress closeness to the Concord BART station as a selling point. A faster pace of growth will begin years prior to BART construction with a commitment to build the extension. The corridor could become substantially like the accelerated growth alternative discussed above, unless new land use controls are initiated and implemented before the period of BART detailed design and construction. The concentrated growth future will be impossible to achieve unless conservation elements and limits to urban service expansions now under consideration by area governments are implemented in the mid-1970's.

ROUTE ALTERNATIVES

Once the preceding work was completed, the major corridor growth and BART service options were decided upon for the various line and station alternatives and those different segments which were feasible in terms of construction and community impact were connected to form seven basic extension alternatives, each offering a different overall future for the corridor. The alignments are shown in Figures 4-5 through 4-11, while the growth assumptions that were used for the different sections of the corridor for each extension are listed in Table 4-2. The limits of the various areas included in Table 4-2 are shown in Figure 4-4.

The seven alternatives being evaluated each combine a BART extension route and a set of stations with a development strategy comprising: zoning and subdivision regulations, redevelopment programs, public works and services, and other governmental actions bearing on change in the corridor.

CORRIDOR DEVELOPMENT STRATEGIES

The characteristics of the corridor today are a starting point for the different directions future growth in the corridor could take. Today's characteristics somewhat limit the amount of change which can occur in the corridor. A concerted effort to create new growth patterns by regulating all construction from now to 1980 would affect only about 20 percent of the predicted accumulated total corridor housing and commercial activity. Nevertheless, the level of existing development has not reached a point where desired changes cannot be brought about.

Table 4-2. Alternative Growth Assumptions

Route Alternatives	1	2	3	4	5	6	7
Pleasant Hill	◩	◩	◩	◩	◩	■	■
North Martinez	◩	□	□	■	◩	□	□
South Martinez	◩	□	□	■	◩	□	□
North Concord	◩	◩	◩	◩	◩	□	□
Concord	◩	◩	◩	◩	◩	□	□
East Concord	◩	◩	◩	◩	◩	■	■
Clayton	◩	◩	◩	◩	◩	■	■
West Pittsburg	◩	◩	◩	■	◩	■	■
North Pittsburg	◩	◩	◩	■	◩	■	■
South Pittsburg	◩	◩	□	■	◩	■	■
orth Antioch	◩	□	□	■	◩	■	■
South Antioch	◩	◩	□	■	◩	■	■
East of Antioch	◩	◩	□	■	◩	■	■

□ Trend ◩ Concentrated ■ Accelerated

The different directions growth of the corridor could take result from many market factors which are strongly influenced by the following:

1) General plans, zoning and subdivision regulations, public ownership of land, and other governmental regulations bearing on land use development.

2) The capacity and relative location of public works and services to new growth areas, such as waste disposal, water systems, schools, police and fire protection.

3) The location and capacity of transportation improvements, including a BART extension and SR-4, which make the corridor more convenient to other urban areas.

4) Population pressure and economic condition of the general area.

These influences produce an overall direction of growth which can be evaluated in terms of its community and environmental impacts and transportation service characteristics.

Essentially, some of the BART extension alternatives assist the implementation of these plans, other alternatives explore new or modified development strategies encouraged by a BART extension. The seven alternatives summarized in this section are based on the following major options for corridor growth.

Concord/Clayton Valley

- Concord can continue to encourage growth in the eastern portion of the City, in the areas shown for residential expansion by the Concord General Plan. This pattern could be reinforced by developing a major second activity center in the area, using either the Performing Arts Center or College site as a nucleus. Alternatives 6 and 7 explore encouragement of growth of lower density suburban communities with BART extensions emphasizing local automobile access to stations and commute transit service to other parts of the Bay Area. Alternative 5 is similar, but explores continued growth of eastern Concord by increases in residential density rather than development of new rural land. The alternatives will also enable an evaluation of the effect this strategy has on downtown Concord.
- By discouraging continued growth in the eastern portion of the City and Clayton, future development could be redirected into the existing downtown area of Concord. Alternatives 1-4 explore use of a BART extension as part of this strategy, to begin building the elongated downtown core described in the Central Area Plan. The alternatives also will enable an evaluation of the effect on the downtown of a

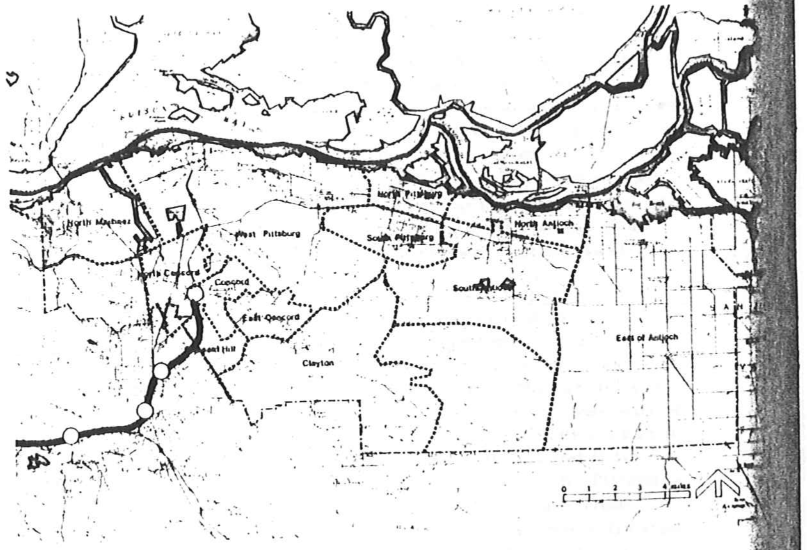


Figure 4-4. Corridor Subareas

new activity center in the U.S. Naval Weapons Station.

Pittsburg/Antioch

- West Pittsburg, Pittsburg and Antioch can make a major effort to revitalize older areas of their communities north of SR-4. Alternatives 1 and 5 explore expanding present efforts toward revitalization, including redevelopment and Model Cities Programs in Pittsburg and substantial private investment in restoring downtown Antioch. An expanded revitalization strategy would locate BART extension stations in downtown Pittsburg and Antioch to increase their attractiveness. Future development would be redirected to the areas north of SR-4 by establishing a limit to urban expansion. Alternatives 2, 3, 4 and 6 explore development of a community center in West Pittsburg, although the area is now unincorporated, making it more difficult to initiate the other steps which would be required to revitalize the community.
- Current land use controls, public works programs, and plans envision continued suburban growth south of SR-4. Alternatives 2, 4, 6 and 7 explore extensions which will serve and further generate low density single family home development. Alternatives 4, 6 and 7 assume suburban growth resulting from a continuation of present land use control practices. Alternative 2 explores supporting this growth direction with a program to establish new major activity centers more central to the future communities of Pittsburg and Antioch. All of these alternatives will enable an evaluation of the effect of suburban growth on the older areas of these communities.
- Alternative 3 explores a compromise development strategy to accomplish both downtown revitalization and suburban growth.

East of Antioch

- Contra Costa County staff have finalized the Open Space Element of the County General Plan which envisions continued agricultural and open space use of the East County. Land use controls, such as a moratorium on subdivisions and a 10 acre minimum lot size for agricultural zones will be needed to implement the plan. Suburban development in East County could be discouraged by these controls: public purchase of open space and not providing urban services. However, other incentives may be required for agricultural use of the area to continue. Alternatives 1 and 5 explore the possibility of complementing these controls and incentives with a BART extension serving concentrated development in already urbanized areas. These alternatives enable an evaluation of the BART patronage implications of limiting urban expansion into East County, and also enable a determination as to whether or not the Open Space Conservation Plan and a BART extension are compatible.
- Alternatives 3, 4, 6 and 7 explore the growth direction which will result if residential development does occur in East County. These alternatives provide stations emphasizing local automobile access and BART service to commuters with jobs or other destinations outside the corridor. This type of extension design is most encouraging of suburban growth and requires substantial growth to provide BART ridership comparable to patronage from stations on the Concord line.
- Alternative 2 explores combining both population growth in the East County and preservation of agriculture by development of a new town to accommodate 50,000 people or more. The town would be located in Lone Tree Valley where natural resource studies indicate limited environmental damage from development and avoidance of the higher development costs of suburban lower density development in an area further east. Changed development patterns, emphasizing pedestrian orientation to community facilities and the BART station and high density housing, would allow open space and agricultural conservation elsewhere in the area.

An Extension-Growth Alternatives Memorandum (May 2, 1973) provided a description of the development strategies for each corridor alternative.

EVALUATION OF EXTENSION-GROWTH ALTERNATIVES

The approach of the evaluation method was to present information on the direct and indirect impacts of BART extension alternatives in a simple and straight forward manner. For each of the criteria discussed in Section 2, information was collected describing each alternative's effect on the corridor and developed to a level of detail sufficient to arrive at reasonable choices between the alternatives. Some criteria overlap and interact with others, and the evaluation process was not regarded as a rigid structure into which all information must fit.

Instead of going into a detailed narrative in the main body of the report of the comparison of the seven alternatives that occurred during the second phase of the evaluation process, only a summarized rationale for the selection of two alternatives is included in this section along with the reasoning for eliminating the other five extensions. Details of the evaluation work, in the form of tables of comparison, are contained in Appendix D.

Recommendations

The recommendations were that two BART extension-growth alternatives be studied further: Alternative 1 with some modifications, and Alternative 4.

In their most southerly sections, Alternatives 1 and 4 had the same alignment, specifically from the Concord Station via Port Chicago Highway to State Route 4. At that point, Alternative 1 continued along Port Chicago Highway, while 4 turned easterly over Willow Pass. A station was placed at Port Chicago on Alternate 1 in anticipation of extensive future residential development in that area (3). The line then continued easterly along Port Chicago Highway, the Southern Pacific tracks, Sacramento Northern right-of-way and into stations in downtown Pittsburg and Antioch. When it become apparent that development plans at Port Chicago were too hypothetical since they depended upon the abandonment of the U.S. Naval Weapons Station, the alignment through that area was dropped. Alternative 1 was then altered to agree with Alternative 4 to the east slopes of Willow Pass. In this area the modified line diverges in a northeasterly direction across the intersection of Port Chicago Highway and Willow Pass Road, connecting to the Alternative 1 alignment at the Sacramento Northern Railroad. This, of course, resulted in the creation of West Pittsburg Station site that had not been considered in the earlier studies. The development strategy and corridor growth characteristics associated with the alternative are the same as those described for Alternative 1. The modified alignment takes advantage of the reconstruction of SR-4 over Willow Pass and follows the freeway between Port Chicago Highway West and Port Chicago Highway East.

Alternative 4 remains as described earlier, following the reconstructed SR-4 over Willow Pass and continuing in the freeway median to stations at Bailey Road in West Pittsburg, Railroad Avenue in Pittsburg, and a terminal station at "A" Street in Antioch.

Modified Alternative 1 - The nature of the impacts of Modified Alternative 1 are the same as those of Alternative 1. Slight differences will exist however, in the extent of the impacts for various areas since four stations are recommended on the modified route while there may be only three on the Port Chicago route. Key reasons for recommending this alternative were generally the same as for Alternative 1 and were as follows:

- Community Impacts - Displacement of homes, jobs, businesses and other direct community impacts are least for this alternative. No barriers to existing community access will be created and local street access to the stations will be good if improvements endorsed by Pittsburg and Antioch are made. Other overall impacts are more limited than with other alternatives if housing and employment programs and business assistance programs are expanded, so that people and businessess in older areas will benefit from the redevelopment which can occur around stations.
- Development/Redevelopment Potential - Modified Alternative 1 provides the best opportunity to accomplish plans and goals for the corridor which stress revitalizing the older areas of central Concord, West Pittsburg, Pittsburg and Antioch, as well as plans being considered by corridor citizens and governments to conserve the hills and agricultural land in East County. By creating

communities where people have a real choice to walk, bike and travel by public transportation, rather then relying on the automobile, this BART extension also accomplishes key objectives of the proposed Regional Transportation Plan. The extension can provide these opportunities by redirecting growth, and the substantial new market potential for goods and services created by growth, back into urban areas of the corridor rather than spreading growth into rural areas. Modifications of Alternative 1 have resulted in the shortest route between a north Concord station and West Pittsburg, while preserving the important option of a route through the Port Chicago area. If the U.S. Navy abandons the Weapons Station, a station here could serve a new community, major port or regional recreation area.

- Environmental Impacts - Alternative 1, with control of urban expansion into the hills and agricultural land in East County, results in less damage to the natural environment and minimizes hazards to urban growth, such as landslides, flooding, fire hazard, and earthquake damage.

- Level of Service - Although stations along this route take a few minutes longer to reach by automobile from communities south of SR-4 than stations of the other alternatives, this route provides the best overall transportation service for all people and activities. It locates stations within walking distance of neighborhoods where many people have no automobile and close to existing and future shopping, community facilities, recreation and commercial and industrial job locations along the water. By locating stations in the downtown areas of Pittsburg and Antioch, the opportunity is provided for local feeder transit to serve people living in the corridor as community public transportation to these activity centers. Alternative 1 improves BART service to northern Martinez via SR-4, and provides the opportunity for local feeder transit from this area. However, it does not provide improved BART service to eastern Concord.

- Right-of-Way, Construction and Operations - Alternative 1, with modifications, is the least expensive of the BART extensions studied by the project. However, the Willow Pass option is only slightly less expensive than an alignment through the Port Chicago area if the latter alternative consists of aerial and at-grade construction through the U.S. Naval Weapons Station in Port Chicago. This extension provides the same service schedule as the BART Concord line and is the same as other alternatives in meeting BART's design and operating standards.

The study team recommended this alternative for further evaluation so that the real possibility of changes in zoning and subdivision, public works and services, programs, and community attitudes toward liveability which are necessary to begin a new direction of corridor growth could be studied.

Alternative 4 - Key reasons for recommending this alternative were as follows:

- Community Impacts - Without assistance to people and businesses in areas redeveloped in association with Alternative 1, Alternative 4 will be the most limited in its overall community impacts, although older areas in the corridor will gradually decline. This extension route will be slightly less noisy than Alternative 1 since most of the line is in median of SR-4, a major noise source itself, but requires land for construction which will displace more houses and businesses.

- Development/Redevelopment Potential - This route stimulates growth which is most consistent with the trend of government land use regulation, which extends roads, sewers, flood control and other urban services into rural areas after applications for new development have been approved. This BART extension encourages low density spread growth into the hills and agricultural lands of central and East County, and generates a large market for new shopping and services in growth areas south and east of SR-4.

- Environmental Impacts - Overall environmental impacts were not a reason for choosing this alternative, although direct new impacts of the line itself are the most limited. This BART extension will stimulate a continuation of spread suburban growth at a more rapid pace than trends, resulting in considerable hazards to new growth in rural areas and damage to farm lands, wildlife habitats, plant communities and other irreplaceable natural resources.

- Level of Service - This route places BART stations and ample

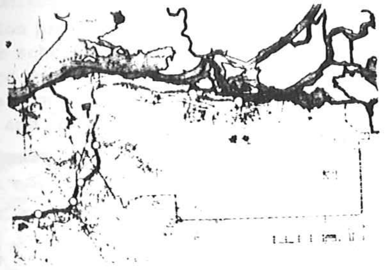


Figure 4-5. Alternative Extension 1

- Route follows Port Chicago Highway through Clyde and weapons shipment area of U.S. Navy Weapons Station.
- Station located opposite Mallard Reservoir.
- Route follows SNRR through Pittsburg and ATSF through Antioch.
- Station located on 8th Street near Railroad Avenue in Pittsburg.
- Terminal station located on waterfront in downtown Antioch.

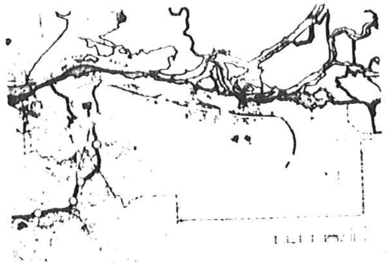


Figure 4-6. Alternative Extension 2

- Route follows Port Chicago Highway through Clyde and U.S. Navy Weapons Station.
- Station located on site of Port Chicago.
- Route follows Mokelumne Aqueduct to Camp Stoneman; follows SR 4 through Pittsburg and Antioch.
- West Pittsburg Station at Bailey Road.
- Pittsburg Station at Camp Stoneman.
- Antioch Station at County East Shopping Center.
- te follows SP tracks and curves around to Lone e Valley.
- :minal station in Lone Tree Valley.

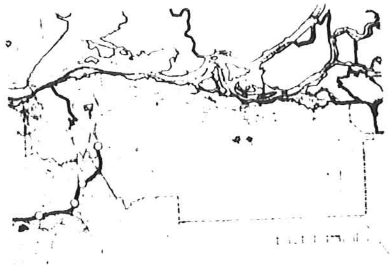


Figure 4-7. Alternative Extension 3

- Route follows Port Chicago Highway through Clyde and weapons shipment area of U.S. Naval Weapons Station.
- Station located opposite Mallard Reservoir.
- Route follows Willow Pass Road through West Pittsburg, Parkside Drive to Pittsburg and SP tracks to Antioch.
- Station in West Pittsburg at Willow Pass Road and Port Chicago Highway.
- Station near Railroad Avenue in Pittsburg.
- Terminal station at "A" Street in Antioch.

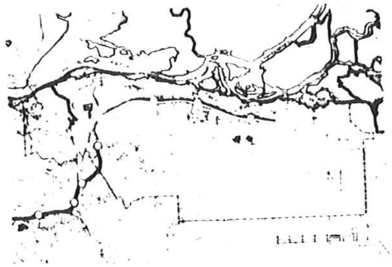


Figure 4-8. Alternative Extension 4

- Route follows Port Chicago Highway, then goes along SR-4 median over Willow Pass Road.
- Station located on Port Chicago Highway two miles north of downtown Concord.
- Route continues in SR-4 median.
- Station at Bailey Road interchange.
- Station at Railroad Avenue interchange.
- Terminal station in Antioch at "A" Street.

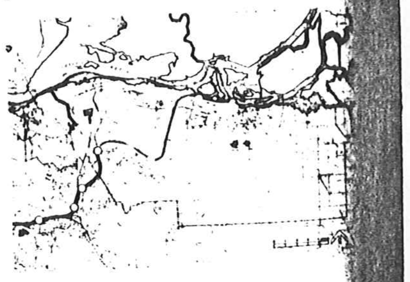


Figure 4-9. Alternative Extension

- Route follows Concord Blvd. to Kirker Pass Road and tunnels through hills to Pittsburg.
- Station located near Performing Arts Center at Kirker Pass Road.
- Route emerges from tunnel to follow the ATSF Railroad through Pittsburg and Antioch.
- Station in Pittsburg at Railroad Avenue.
- Terminal station in Antioch along waterfront near downtown.

parking within a convenient drive by automobile from the communities where most people will live if accelerated growth occurs. If trends continue, most future corridor residents will work elsewhere in the region and this route is also most accessible to areas where large numbers of commuters will live. Alternative 4 improves BART service to northern Martinez via SR-4, and provides the opportunity for local feeder transit from this area; however, it does not provide improved BART service to eastern Concord.

- Right-of-Way, Construction and Operations - The cost of Alternative 4 is slightly higher than Alternative 1, modified, although comparable to Alternative 2 and 3, and substantially less than Alternatives 5, 6, and 7. This extension provides the same service schedule as the BART Concord line and is the same as other alternatives in meeting BART design and operating standards.

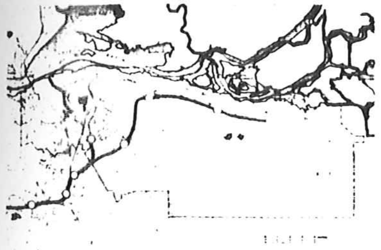


Figure 4-10. Alternative Extension 6

- Route branches from existing BART line at Oak Grove Road, tunnels through Lime Ridge and follows Bailey Road.
- Station located on Bailey Road near Clayton Road.
- Route tunnels through hills to join SR-4 at Bailey Road interchange; follows SR-4 median to Antioch.
- West Pittsburg Station at Bailey Road interchange.
- Terminal station at County East Shopping Center.

The study team recommended further evaluation of Alternative 4 to assess what the effect on BART ridership would be of expanding SR-4 in a joint transportation facility, and to determine whether new land use controls or urban service policies could be implemented along with this BART extension to minimize the environmental impacts of growth.

RATIONALE FOR DROPPING ALTERNATIVES FROM CONSIDERATION

The remaining alternatives were not recommended for further study for a variety of reasons:

Alternative 2 - This alternative explores the idea of building concentrations of shopping and apartments in new centers that are closer to the middle of West Pittsburg, Pittsburg and Antioch. The route also extends to a new community in Lone Tree Valley and provides the option for a station in the Port Chicago area, if the U.S. Navy abandons the Weapons Station. The "new centers" idea has been found to be inconsistent with both existing and new plans and goals for corridor growth. The Lone Tree Valley new community site was selected because relatively limited environmental damage could result from its development. However, the site is too small to accommodate even at very high densities, sufficient population to justify the costs of development and of the additional length of the BART extension. The alternative is less convenient by automobile than Alternative 4 and does not serve neighborhoods with low car ownership, job concentrations and commercial centers other than County East. The community impacts of this route are substantial. This BART extension costs more than Alternatives 1, 3, and 4 without correspondingly improving transportation service or decreasing growth impacts.

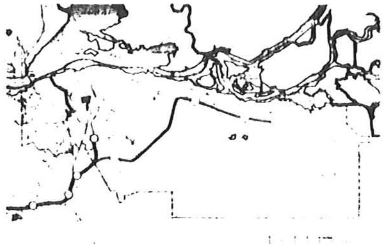


Figure 4-11. Alternative Extension 7

- Route branches from existing BART line at Oak Grove Road; tunnels through Lime Ridge to State College site and then tunnels through hills under Kirker Pass to join SR-4.
- Station located north of college site on Ygnacio Valley Road.
- Route emerges from tunnels to join SR-4 west of Railroad Avenue and follows SR-4 median to Antioch, Pittsburg.
- Station located between Railroad Avenue and Harbor Drive.
- Terminal station at "A" Street in Antioch.

Alternative 3 - This BART route displaces the most houses, businesses and jobs of all alternatives and is the noisiest in residential areas. It creates the most separation of residential areas in Pittsburg and Antioch. The route complies with plans and goals of Concord and Martinez but is inconsistent with revitalization plans for Pittsburg and Antioch. Growth associated with the alternative is incompatible with plans to conserve hills and rural land in East County, and would result in moderate environmental impacts. This alternative is not convenient by automobile and has poor local street access. However, stations are located within walking distance of neighborhoods with low automobile ownership.

Alternative 5 - This alternative is similar to Alternative 1 in conservation of rural land, service and opportunities to revitalize corridor downtowns. In addition, it provides nearby BART service to commuter neighborhoods in east Concord and Clayton as an alternative to overloaded arterial street routes to the existing BART line. However, it does not improve service to Martinez, Port Chicago or West Pittsburg. Overall community impacts are low if the Concord Boulevard section is in subway. It is also low in environmental impacts providing additional pressure for development in the extremely sensitive area east of Concord is strictly limited. However, the cost of this alternative is only exceeded by Alternative 7 and would be highest of all with the Concord Blvd. subway.

Alternatives 6 and 7 - These alternatives had similar characteristics. Direct community impacts were high for both alternatives. The growth associated with the alternatives is not consistent with plans for revitalization of existing downtown areas in Concord, Pittsburg and Antioch, as well as conservation and open space plans for preserving the hills east of Concord and agricultural lands in east County. Although these alternatives have good local street access, they bypass downtown Concord and Martinez, and are not convenient to neighborhoods with low automobile ownership or to job concentrations in Pittsburg and Antioch. Scheduling characteristics are a major disadvantage, since the interval between BART trains on these routes will be twice that on the remainder of the Concord line. Alternative 7 costs the most of all the alternatives. Alternative 6, together with Alternatives 2 and 5, are the next most costly.

FINAL SELECTION

In the third phase of the evaluation process, impact data developed for the two selected alternatives was reanalysed in order to provide residents of the corridor and their elected officials and city and county agencies with an opportunity to compare and weigh the advantages and disadvantages of route Alternative 1 and route Alternative 4 and their respective growth options.

The critical choice which had to be made was between the implications of the BART-growth options in terms of community and environmental impacts, development and redevelopment potential and overall system costs and service. To assist in this decision making process, and to ensure maximum exposure to pertinent issues implied in extending BART into the Pittsburg-Antioch corridor, a report describing and comparing these BART growth options was printed in newspaper form and widely distributed to the general public and to interested parties in April, 1974.

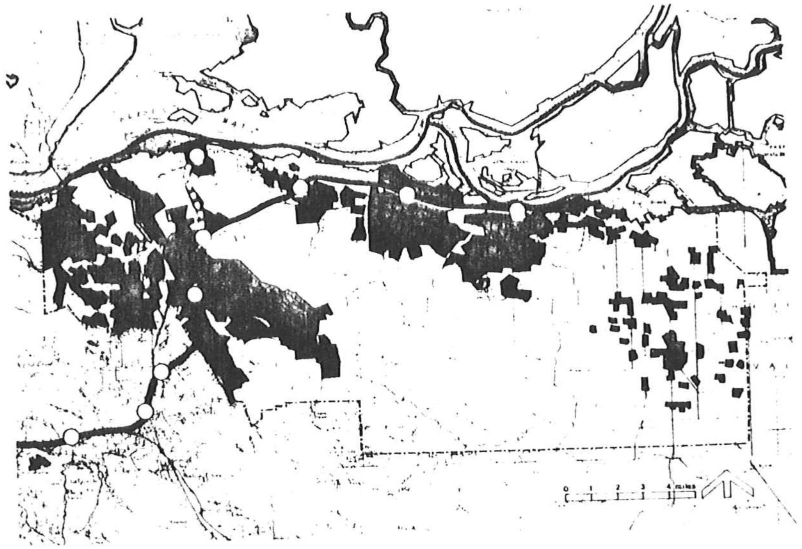
Figure 4-12. BART with Concentrated Growth

▆ Potential Urban Area

━○━ Existing BART Concord Line

━○━ BART Extension Route & Stations

□□□□□ Optional Route



Alternative 1

This BART extension would follow a routing from the downtown Concord Station to a station in North Concord and follow the freeway over Willow Pass to a station in West Pittsburg, downtown Pittsburg and Antioch. Optional routing through the U.S. Navy Weapons Station would provide the opportunity for a station in a new community, port or recreational area in Port Chicago if the Weapons Station is abandoned prior to construction of the extension.

CORRIDOR AREA	ROUTE AND STATIONS	DEVELOPMENT STRATEGY	GROWTH DIRECTION	BART SERVICE
CONCORD/ CLAYTON	• Route follows Port Chicago Highway and then goes along SR-4 over Willow Pass. • Station located on Port Chicago Highway two miles north of downtown Concord. • Optional route if U.S. Navy abandons Weapons Station, follows Port Chicago Highway through Clyde and Port Chicago. • Optional route station in Port Chicago area.	• Provide additional public works and services in eastern Concord/Clayton only to serve already committed growth. • Redevelopment program for downtown Concord. • Restrictions on new residential development in eastern Concord/Clayton. • Preserve hills, Lime Ridge and U.S. Navy lands in open space. • Develop new activity center in Port Chicago even if U.S. Navy relinquishes Weapons Station.	• Slow growth of single family suburban homes and substantial increase of apartments by infilling and replacement of older areas of Concord. • Intensification of commercial areas by more concentrated shopping and office construction. • Slowed growth in eastern Concord/Clayton; no absorption [illegible].	• Existing station serves Concord via city streets. • Local bus system provides rush hour service to station area. • North Concord Station serves northern and central Martinez via SR-4.
PITTSBURG ANTIOCH	• Route follows SNRR through Pittsburg and ATSF through Antioch. • West Pittsburg Station. • Station located on 8th Street near Railroad Avenue in Pittsburg. • Terminal Station located in downtown Antioch.	• Redevelopment and restoration programs for downtowns of Pittsburg-Antioch, including public and private investment. • [illegible] restrictions on residential development [illegible] program to preserve existing open space. • Provide additional public works and services only to urban area. • Do not reconstruct SR-4 east of Bailey Road. • Develop marinas and water-oriented recreation facilities.	• No growth of residential areas south of SR-4; apartment growth around downtowns. • Growth of general shopping/new office buildings in downtowns. • Expansion of marinas/restaurants and specialty shopping. • Industry modernization and growth on existing industrial sites. • Continued grazing and farming of open space areas.	• Service to low- and moderate-income families and apartment dwellers in older areas of Pittsburg-Antioch. • Stations [illegible] and kiss-ride service from suburban areas of SR-4. • Convenient by walking or feeder bus to employment locations of people arriving by BART.
EAST OF ANTIOCH	None	• Comprehensive program to preserve farming with 10-acre minimum lot size, no new subdivision, agricultural land assembly and tax incentives. • No expansion of waste disposal, flood control, water supply, power and road systems. • Public purchase of open space not used for farming.	• No development. • Continued farming and grazing. • Expansion of recreational open space.	• Local feeder bus service from Oakley-Brentwood ar

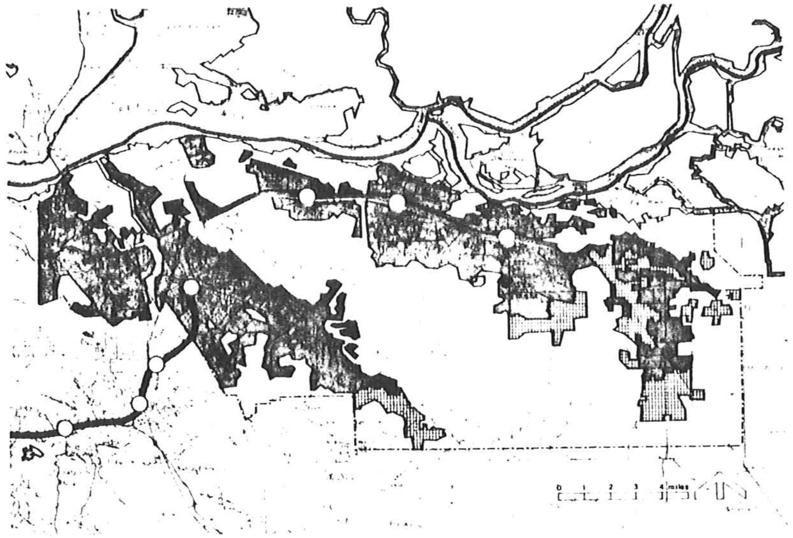
Figure 4-13. BART with Accelerated Growth

▨ Potential Urban Area

▦ Scattered Development

—○— Existing BART Concord Line

—○— BART Extension Route & Stations



Alternative 4

This BART extension would follow a routing from the downtown Concord station to a station in North Concord and would then follow a widened SR-4 over Willow Pass to stations along the freeway in West Pittsburg, Pittsburg and Antioch.

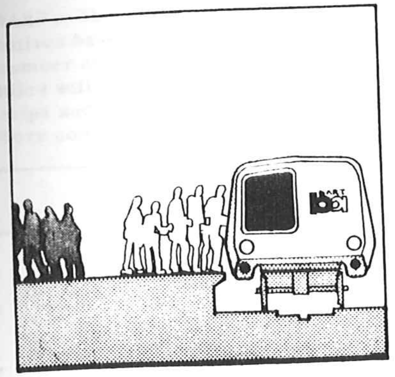
CORRIDOR AREA	ROUTE AND STATIONS	DEVELOPMENT STRATEGY	GROWTH DIRECTION	BART SERVICE
CONCORD/ CLAYTON	• Route follows Port Chicago Parkway, then goes along SR-4 median over Willow Pass. • Station is located on Port Chicago Highway two miles north of downtown Concord.	• Redevelopment program for downtown Concord. • Restrictions on new residential development in eastern Concord/Clayton. • Provide additional public works and services in eastern Concord/Clayton only to serve already committed growth. • Preserve hills, Lime Ridge and U.S. Navy lands in open space. • Develop new activity center in headquarters area if U.S. Navy relinquishes Weapons Station.	• Slow growth [illegible] homes and [illegible] infilling and replacement [illegible] older areas of Concord. • Intensification of commercial [illegible] more concentrated shopping and office construction. • [illegible] Concord and Clayton [illegible] absorption of rural land.	• Existing station. • Local bus system provides rush hour service to station area. • North Concord station serves northern and central [illegible] SR-4.
PITTSBURG	• Route continues in SR-4 median. • Station at Bailey Road interchange. • Terminal Station in Antioch at [illegible] Street.	• Restoration and replacement program for older areas of West Pittsburg, Pittsburg and Antioch. • Provide more social services to declining areas of Pittsburg-Antioch. • Maintain existing apartment zones in West Pittsburg and encourage high density development. • Plan for single family zoning and subdivision south of SR-4. • Expand public works and services to serve new development. • Reconstruct SR-4 to 8 lanes through Antioch.	• Gradual deterioration of neighborhood conditions and [illegible] in older parts of Pittsburg-Antioch. • Growth of apartment and commercial centers in West Pittsburg. • [illegible] development around stations in Pittsburg and Antioch. • Substantial [illegible] growth and land absorption south of SR-4. • Several new commercial centers; expansion of East County.	• Automobile access and parking via improved urban arterials, [illegible] areas. • Some service to lower and moderate income families and apartment dwellers in older areas of Antioch and Pittsburg. • Limited service to industrial job locations. People [illegible] BART. • Local bus system provides rush hour service to station area.
EAST OF ANTIOCH	None	• [illegible] East County [illegible] development, [illegible] planned [illegible] lots. • Extensive public works and services expansion. • [illegible] • [illegible] • [illegible]	• Substantial suburban growth in East County. • [illegible] • [illegible]	• Automobile access and parking via major new road system in East County. • Service to predominantly commuter suburban families. • Commuter express bus from Oakley-Brentwood area.

The two alternatives were evaluated according to their patronage and transportation service, community impacts, development and redevelopment potential, environmental impacts, right-of-way construction and operations characteristics. The following is a summary of key findings.

Alternative 1

Patronage

The Regional Transit Travel Projections Project (RTTPP) estimates that 16,000-17,000 people per day will ride a Pittsburg-Antioch BART extension in 1990 about one-sixth of the 1990 patronage estimate for all of the Concord line. Although more people live in the extension corridor with Alternative 4, corridor residents with Alternativ 1 modified will be more likely to

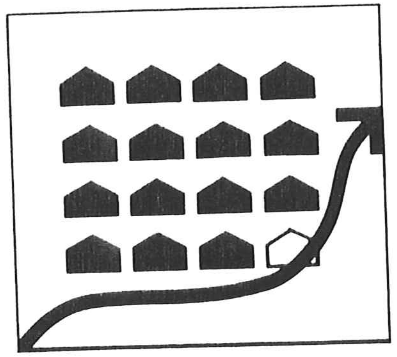


Stations		PATRONAGE (1) Work Trips	Non-Work Trips	All Trips	STATION ACCESS Parking	Potential Bus/Walk-in	Street Circulation	Population/Activities Served	Relationship to Other Transportation
Antioch	By Corridor Residents (2)	8,500	3,600	12,100	400 cars	70% of trips	• Station generated traffic is moderate. • Good street access via several route is planned downtown steeet improvements are made.	• Stations more convenient to major concentrations of public transportation dependent population in corridor.	• Station locations in Pittsburg-Antioch good for local feeder bus routes to provide in-community public transportation to shopping, services, industrial job locations and other activities.
	By Others (3)	300	200	500					
Pittsburg	By Corridor Residents	7,000	4,700	11,700	550 cars	50% of trips	• Station generated traffic is moderate. • Good street access via Railroad Avenue and Harbor if planned improvements are made.	• Stations in Pittsburg-Antioch close to shopping, community facilities and employment areas.	• Antioch station is potential transfer point betw BART and Bay Area-Stockton rail connection bei studied by the Sacramento-Stockton-Bay Area Transportation Corridor Study (SSBATCS) or Amtrak.
	By Others	300	500	800					
West Pittsburg	By Corridor Residents	3,000	2,300	5,300	200	60% of trips	• Station generated traffic is light. • Street access must be developed from Willow Pass Road to station site.		• West Pittsburg Station is potential transfer poi between SSBATCS "BART continuation" to Sacrameato and BART Pittsburg-Antioch line.
	By Others	100	160	200					
North Concord	By Corridor Residents	3,100	1,900	5,000	500 cars	30% of trips	• Station generated traffic is light. • Good street access via SR-4 and Port Chicago Highway.	• Stations are 2-5 minutes longer travel time by automobile from suburban areas south of SR-4 than Altersative 4 stations.	• North Concord Station provides for feeder bus service from Northern Martinez.
	By Others	300	300	600					
Total Extension	By Corridor Residents	21,600	12,500	34,100	1,400 cars	N.A.	N.A.		
	By Others	1,000	1,100	2,100					
Concord	By Corridor Residents	15,600	10,900	26,500	Existing	50% of trips	• Station-generated traffic is moderate to heavy. • Routes to station through downtown Concord will be heavily travelled.		• Bus Express Service will be provided.
	By Others	400	1,900	2,300					

(1) Patronage estimates from RTTPP, Task III, Tests 2 and 3. Patronage is one-way trips.
(2) Includes both productions and attractions.

Community Impacts

Both alternatives will require the relocation of homes, businesses, and community facilities to provide for the BART right-of-way. Alternative 4 necessitates relocating at least 225-235 homes, 140,000 square feet of commercial activity, and several community facilities; nearly five times the direct impact on housing and three times the direct commercial impact of Alternative 1 modified.



RELOCATION IMPACTS Housing	Jobs Commence	Other
Direct Relocation • 40-45 Houses • 14 Apartments, if Antioch Station provides parking Indirect Impacts • Likely increase rents and housing values in North Pittsburg and North Antioch (Low income and fixed income areas) • Likely increase Housing costs in fixed income areas North Concord.	Direct Relocation • 5 Retail businesses (45,000 sq. ft., 55-60 jobs) • 1 Storage building *(can be moved on existing site) Indirect Impacts • Likely decline of marginal businesses in North Pittsburg and Antioch • Slight decline agricultural jobs	• 100' strip through Grammar School Administration Land (presently vacant)

NOISE/PRIVACY IMPACTS Noise Activities	Distance from BART 100'	200'	300'	500'	Privacy Viewed from BART
Houses	270-285	555-570	860-890	1410-1360	290-310
Apartments	10-14	45-60	75-100	160-190	30-40
Schools	1		1	1	
Parks	1	1	1	1	
Hospitals			1		
Others	4				

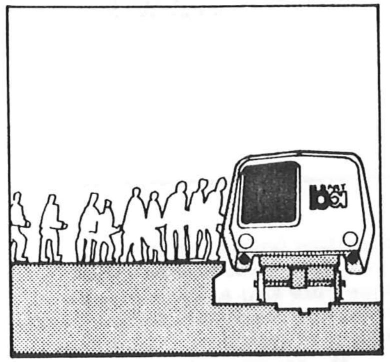
Community Separation

- North Concord: Visual reinforcing of exis'ing separation North Concord community by SNRR & Port Chicago Highwa
- West Pittsburg (R.R.): East of McAvoy Road, a pedestria and visual barrier reinforces the existing railroads separa West Pittsburg from the proposed open space area north of th community (see Pittsburg General Plan).
- Pittsburg (SNRR): If aerial, visual separation between the downtown area and rest of the community. If subway, no
- Antioch (AT&SPRR): BART Station will provide at-grade pe trian and car overcrossing the railroad from downtown to th proposed Marina (see local plans, goals and policies sta remove existing separation.

Alternative 4

ride BART. The result is that both alternatives have about the same total number of riders. Alternative 1 modified will carry more non-work trips and more people from elsewhere commuting into the corridor to work. Alternative 4 will carry more people living in the corridor and working elsewhere in the Bay Area, particularly in downtown San Francisco and downtown Oakland.

Alternative 1 modified locates stations where transfer connections are possible between BART Amtrak service to Stockton or new high-speed public transportation to Sacramento. The patronage of this alternative will increase if these connections are made.

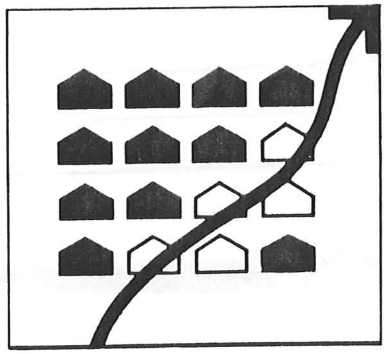


		PATRONAGE (1)			STATION ACCESS				
Stations		Work Trips	Non-Work Trips	All Trips	Parking	Potential Bus/Walk-in	[illegible]	Population/Activities Served	Relationship to Other Transportation
Antioch	By Corridor Residents (2)	11,700	4,200	15,900	1,500 cars	30% of trips	• Station generated traffic is moderate. • Traffic through "A" Street interchange will be heavy; involves several turning	• Stations away from most public transportation dependent population in corridor.	• Requires rebuilding SR-4 from Port Chicago Highway East and "A" Street interchange in Antioch.
	By Others	200	100	300					
Pittsburg	By Corridor Residents	5,600	4,200	9800	600 cars	30% of trips	• Station generated traffic is moderate. • Railroad-Harbor interchange capacity adequate for projected 1990 traffic.	• Stations away from major job locations and community facilities except Pittsburg City Hall/High School complex.	• Station locations inappropriate for transfer points between SSBATCS alternatives and BART.
	By Others	400	400	800					
West Pittsburg	By Corridor Residents	1,600	900	2,500	400 cars	40% of trips	• Station traffic is light. • Willow Pass Road, the major access route, will be heavily travelled by 1990.	• Stations convenient by automobile from suburban areas south of SR-4 and east of Antioch.	• North Concord station provides for feeder bus service from Northern Martinez.
	By Others	100	100	200					
North Concord	By Corridor Residents	2,200	1,500	3,700	400 cars	25% of trips	• Station traffic is light. • Good street access via SR-4 and Port Chicago Highway.		• Bus Express Service will be provided.
	By Others	400	100	500					
Total Extension	By Corridor Residents	21,100	10,800	31,900	2,900 cars	N.A.	N.A.		
	By Others	1,100	700	1,800					
Concord	By Corridor Residents	16,200	8,300	24,500	Existing	40% of trips	• Station traffic is heavy. • Routes to station will be congested by 1990.		
	By Others	400	1,400	1,800					

(3) Does not include trips attracted to corridor stations produced by other corridor stations (intra-corridor trips).
NOTE: Patronage figures for Alternative 4 will be reduced slightly due to increase of headways in downtown San Francisco.

The indirect impact of Alternative 1 modified will be to increase property values and rents in downtown Pittsburg and downtown Antioch. Unless the redevelopment program associated with Alternative 1 modified provides for low-cost housing, such housing will be adversely affected by these increases. Alternative 4 will accelerate the decline of residential areas north of SR-4, thereby increasing the supply of substandard low-cost housing in the corridor.

Noise impacts and loss of privacy to views from passing trains due to BART are comparable for both alternatives. Alternative 1 modified will be a more visible separation of the community in West Pittsburg and Pittsburg if the downtown alignment is on an aerial structure.



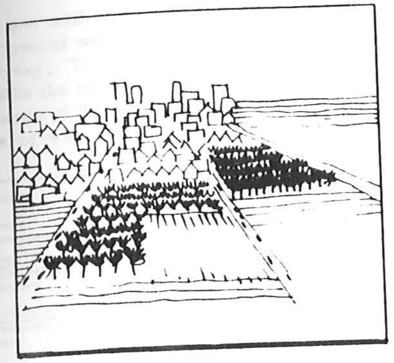
RELOCATION IMPACTS		
Housing	Jobs Commence	Other
Direct Relocation • 135-140 houses • 90-95 apartments Indirect Impacts • Likely increase housing costs in North Concord. • None in Pittsburg-Antioch.	Direct Relocation • 6 retail businesses, 110,000 sq. ft., 130-140 employees. • 1 heavy commercial business, 22,000 sq. ft., 15-20 empl. • 1 wholesale business, 4,000 sq. ft., 2 empl. • 1 warehouse in construction. Indirect Impacts • Slight in urban areas. • Substantial decline agricultural jobs.	• 100' strip through Grammar School Administration land (presently vacant) • 200' strip north side of Ambrose Park. • Water company. • 100' strip of Los Medanos School Playground. • 200' strip of John Marsh School playground. • 2 churches, Elks Club.

NOISE/PRIVACY IMPACTS						
Noise	Distance from BART				Privacy	Community Separation
					Viewed from BART	• North Concord: Visual reinforcing of existing separation North Concord Community by SNRR & Port Chicago Highway. • West Pittsburg (Freeway): BART and expanded SR-4 reinforce the existing barrier that separates the community from the hills. • Pittsburg & Antioch (Freeway): BART and expanded SR-4 reinforce existing separation North & South Communities.
Activities	100'	200'	300'	500'		
Houses	195-205	470-485	800-820	1400-1450	260-280	
Apartments	20	70	112	200-210	50-60	
Schools	1		2	1		
Parks						
Hospitals				1		

Alternative 1

Development & Redevelopment Potential

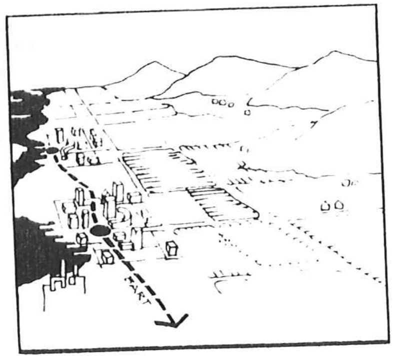
Alternative 1 modified could contribute significantly to the redevelopment of downtown Pittsburg and Antioch while allowing for conservation of rural lands in East County provided a strict adherence is applied to zoning and subdivision controls. This general direction of development and redevelopment is in conformance with both local and county plans, but is neither consistent with zoning in some



DIRECT IMPACTS			INDIRECT IMPACTS			
Conformance With Plans/Goals	Joint Use	Community Activities	Population	Employment	Land Use Characteristics	Public Works & Service Requiremen
• Concord: In conformance with Concord & Martinez plans/goals. • Pittsburg: Consistent with waterfront development, revitalized downtown. Medium density zoning, Open space element. • Antioch: Supports marina-revitalized downtown. • East County: Conforms with conservation and open space element now under consideration.	• Recreational & Social Services • Recreational & Social Services • Joint use of right-of-way in Pittsburg and Antioch.	Within 1/4 mile: 1 Elementary School 1 Municipal golf course Antioch City Hall 1 school administration building Recreation pier Within 1/2 mile: 1 Junior High School Pittsburg City Park Antioch Municipal Court Antioch Senior Citizens Center Pittsburg waterfront	• Moderate increase in population over trend growth, significant influx of moderate income households in older areas of Concord, Pittsburg and Antioch. • Low and fixed income families will continue to live in older areas of corridor only if there are specific programs to provide low cost housing. • Majority of population must be attracted to higher density mixed community lifestyle.	• Concentrates job increase in existing commercial areas. • Slow decline in agricultural employment. • Moderate increase in net out-commute of resident labor force.	• Concentrates land uses in already urban areas. • Potential for new community port or recreation facility if U.S. Navy abandons Weapons Station.	• Moderate

Environmental Impacts

The direct impacts of the BART line and support facilities on the natural environment are moderate. Alternative 4 will stimulate new growth into rural areas that may cause considerable and irreparable damage. damage to the natural environment. These impacts could affect 134 square miles of land with valuable biological resources, agricultural and water resources, or visual and recreational resources. In



• Linear miles of LINE & YARD IMPACTS	• Critical Wildlife Habitats	• Critical Plant Commun.	• Slope Hazards	• Seismic Hazards	• Fire Hazards	• Flood Hazards	• Agricultural and Water Resources	• Visual Recre Resour
Reinforces Existing Impacts	1.44	.68	.04	4.24	N.A.	2.46	5.26	2.46
Creates New Impacts	1.12	.72	-	-	N.A.	.63	2.84	2.56
• Square Miles of GROWTH IMPACTS								
Scattered	Relatively Minimal →							
Dense	Relatively Minimal →							

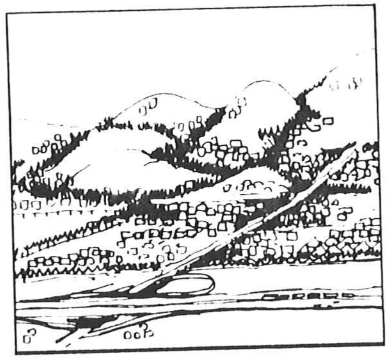
• Example: 13.98 square miles of dense development would affect critical wildlife with Alternative 4.

Alternative 4

areas nor with the pattern of development which has been occurring. This alternative provides the best opportunity for joint uses of BART stations and rights-of-way (e.g. parks, trails, bicycle paths, day care centers) and in developing clusters of community facilities and businesses within walking distance of BART.

Alternative 4 would stimulate overall population growth in the area and encourage the spread of new development to the south and east of the existing urban area. This general direction of development conflicts with the preliminary plans of Pittsburg, Antioch and the County, although it continues the pattern of development which occurred until late 1973.

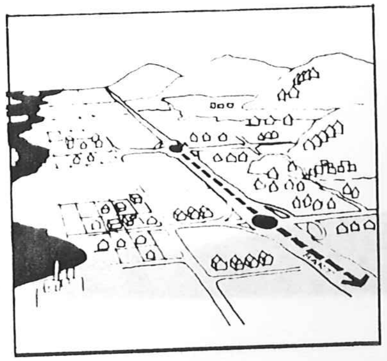
DIRECT IMPACTS			INDIRECT IMPACTS			
Conformance With Plans/Goals	Joint Use	Community Activities	Population	Employment	Land Use Characteristics	Public Works & Service Requirements
• Concord: In conformance with Concord & Martinez plans/goals.	• None	1/4 mile: 3 schools creative art auditorium	• Substantial increase in population, significant influx of higher income families into suburban areas south of SR-4 and East County.	• Dispersed population serving businesses spread job increase, job increase does not match predominate white collar skills of resident labor force.	• Spreads new development.	• Extensive
• West Pittsburg: Inconsistent with open space element.	• None	1/2 mile: 5 schools 2 parks Pittsburg Civic Center & City park County Administrative Building Community Hospital Teen center	• Decline of older areas of Pittsburg and Antioch provides low cost housing for low and fixed income households.	• Substantial decline in agricultural employment		
• Pittsburg: Inconsistent with most planning intentions; consistent with current zoning.	• None		• Majority of population must still prefer spread suburban community lifestyle.	• Substantial increase in [illegible] out-commute.		
• Antioch: Inconsistent with preliminary downtown plan.	• None					



addition, nearly 80 square miles of hazard areas subject to slope failure, high seismic response, fire and flooding will jeopardize the new growth stimulated by Alternative 4. Many of the impact areas are overlapping.

Provided zoning, subdivision controls, limitation of urban services expansion, and other government actions that are part of Alternative 1 modified are strictly adhered to, this alternative has few adverse impacts on the natural environment since it redirects new growth away from rural lands and back into existing urban areas. If a commitment is not made to these governmental actions, Alternative 1 modified will have significantly greater environmental impacts, but still not nearly as serious as with Alternative 4.

• Linear miles of LINE & YARD IMPACTS	• Critical Wildlife Habitats	• Critical Plant Commun.	• Slope Hazards	• Seismic Hazards	• Fire Hazards	• Flood Hazards	• Agricultural and Water Resources	• Visual and Recreation Resources
Reinforces Existing Impacts	4.72	.44	2.78	2.48	N.A.	.51	12.90	5.57
Creates New Impacts	-	-	.05	.11	N.A.	-	.13	.26
• Square Miles of GROWTH IMPACTS								
Scattered	.82	5.89	.56	.01	0	5.76	17.50	23.47
Dense	13.98*	6.84	4.26	62.23	0	6.46	21.42	44.21



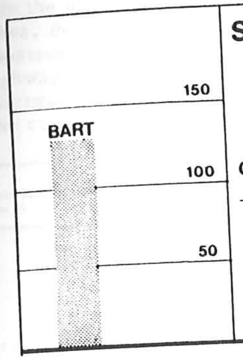
* Example: 13.98 square miles of dense development would affect critical wildlife with Alternative 4.

Alternative 1

Costs

Construction cost is approximately the same for both alternatives. The cost of Alternative 1 modified, including cost of rights-of-way, construction of all facilities, additional BART vehicles required by the extension, and contingencies and management is $137 million (est. in 1973 dollars). Comparable costs for Alternative 4 are $143 million; however, the cost of reconstructing SR-4 to fit BART

Summation



Cost $ millions ('73 dollars)	
BART	137
Total	137

		Vehicles Required		Additional Vehicles Required	
Construction Cost (1)	Ultimate Train Headways Peak Hour (Minutes)	Trains Req'd on line	Vehicles Req'd on line (3)	Vehicles Req'd with spares (4)	Net Increa
$137 (2)	6	24	172	191	29

(1) All costs in Millions of 1973 dollars; excludes; interest, inflation and financial charges, landscaping, specialty contracts, fare collection, utilities and agreements, insurance, and cost of pre-operation and testing.

(2) Subway construction through City of Pittsburg, add $18 Million.

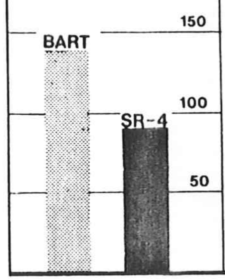
into the median is $42-48 million. Thus, the combined cost of constructing the joing BART highway corridor envisioned by Alternative 4 is $185-191 million. The combined costs of BART, the highway and any other regional transportation projects in the corridor will be considered by MTC when allocating regional transportation funds to the various parts of the Bay Area.

Vehicle requirements, frequency of service and other operating characteristics are comparable for the two alternatives.

It must be remembered that these costs are for compar tive estimates only and are in 1973 dollars.

		Vehicles Required		Additional Vehicles Required	
Construction Cost (1)	Ultimate Train Headways Peak Hour (Minutes)	Trains Req'd on line	Vehicles Req'd on line (3)	Vehicles Req'd with spares (4)	Net Increase
$143 (5)	6	24	166	207	45

(3) 147 on-line vehicles required for service to Concord in 1990 without extension.
(4) 162 vehicles required including spares without extension.
(5) Associated with Alternative 4 are additional freeway improvement costs of $42-48 million.



Summation

Cost $ millions ('73 dollars)

BART	**143**
SR-4	**48**
Total	**191**

PUBLIC REVIEW OF ALTERNATIVES

As a follow-up to the distribution of the preceding information, a review process was begun encompassing the Citizen and Technical Advisory Committees, various City councils representing communities within the project study area, other interested parties, and residents of the corridor. For those citizens of the area who had not had the opportunity to become involved in the project up to this point, two public meetings were held in May, one in Concord for residents of Concord and Martinez, the other in Antioch for those living in Pittsburg, Antioch and the East County. Based upon a general endorsement obtained in this review period, and strongly influenced by official recommendations of the City councils of Pittsburg and Antioch, the Board of Control voted Alternative I Modified as the recommended extension. However, this recommendation does not preclude final adoption of a Port Chicago route (Alternative I) if it is found feasible and acceptable at the time of final location and design. The underlying reason for this selection was a desire within the corridor to retard the rate of development of the remaining open space and at the same time rejuvenate the older, deteriorating portions of the East County, mainly in Pittsburg and Antioch.

Section 5: Recommended Route and Stations

The length of the BART extension from the Concord Station to and including the Antioch Station is a little over 14-1/2 miles. The line consists of several types of construction and for the purposes of this report has been divided into zones with boundaries at the locations where the construction type changes or on either side of the station structures. The purpose of breaking the line into zones was to provide a description of impacts as they relate to each section type. In the following narrative and on the accompanying drawings, Figures 5-1 through 5-3, impacts of the BART line on 19 zones lettered "A" through "S" are described in terms of lineal feet of natural resource impacts and community impacts.

Concord to North Concord

The extension begins at the north end of the existing Concord Station platform. The line, on aerial structure, curves immediately to the west through an area of both commercial and residential development and moves into an aerial alignment in the median of Port Chicago Highway. The portion from Concord Blvd. to just north of the park is on a wide aerial structure due to the need for a double-ended turnback track north of the Concord Station. It is presently planned to reconstruct this highway as far as SR-4 into a four lane arterial at the same time that the BART extension is constructed. It is assumed that the existing Sacramento Northern Railroad property adjacent to the highway will be available for use permitting a BART alignment in the median of Port Chicago Highway. The line continues northerly in the median until it crosses over the northbound lanes in the vicinity of Ranchito Drive, just behind several private residences and into an aerial station located east of Port Chicago Highway in the vicinity of Sun View Terrace.

Development along this first portion of the line dictated the need for a detailed analysis of noise impacts and associated relocation requirements.

Predicted noise levels generated by BART were determined for varying distances from a BART aerial structure. Once this data had been gathered, the values were compared to projected ambient noise levels. Though noise generated by Sacramento Northern Railroad freight trains has been inconsequential since the early 1960's, the maximum decibel levels caused by existing car and especially truck traffic along the highway can be as high for short periods of time as those emanating from the BART trains. Furthermore, the noise produced by auto and truck traffic will become more severe when the highway is widened to four lanes. With a predicted Average Daily Traffic flow of 20,000 vehicles in 1990, noise levels for peak hour flows, taking into account the affects of lower speeds and grades on trucks, may be comparable to those from BART. For example, noise levels generated by traffic during the most active 10 percent of the peak hour at a distance of 100 feet from the roadway, assumes 2,000 vehicles per hour travelling at 40 miles per hour with 5 percent trucks and a level roadway grade would be in the region of 71 to 76 dBa. The difference between this sound level and the levels generated by 10-car BART trains travelling at 80 miles per hour on an aerial structure equipped with sound barriers, is very small. However, both of these levels fall within the range of unacceptable noise according to criteria established by HUD, FHWA, and the EPA. In the vicinity of the station, lower noise levels generated by the slower speeds of the trains will be somewhat offset by the sounds caused by braking. The station has been moved to the east away from the residential areas on the west side of the highway.

Due to the apparent small differences in noise levels and the present uncertainty as to legal implications of federal noise standards, no conclusion was reached at this time as to the extent or necessity to purchase homes paralleling Port Chicago Highway. This decision will require further study when the line is committed and will have to be balanced against the attitudes of the persons owning the residences involved.

As part of the study of how to reduce noise levels, a depressed BART alignment in the median of Port Chicago Highway was analyzed. This type of design will in most cases result in lower noise levels, however increased space requirements will necessitate the purchase of approximately 60 percent of the homes that may have to be purchased with the aerial line. The overall cost of both alternatives was about the same up to the North Concord Station but through the station and north of it the cost of the depressed alignment would add several million dollars.

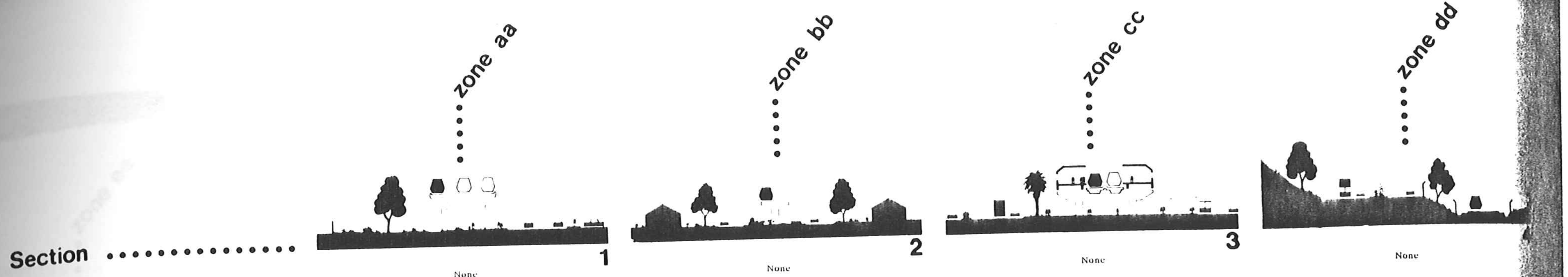
The end result is that an aerial line is proposed for this section. The final resolution of the right-of-way purchase and the final location of the BART lines should be settled in the first phases of final design and be based on a more detailed study.

North Concord to West Pittsburg

North of the station the line continues on aerial structure for a short distance, thence into an at-grade configuration between Port Chicago Highway and the soon-to-be-built on-ramp to State Route 4 on one side and a relocated track belonging to the U.S. Naval Weapons Station on the other side. The line then curves to the east, descends into subway beneath the eastbound lanes of SR-4 and ascends into an at-grade alignment in the median of the freeway. Certain construction problems will arise in this area due to the need to maintain traffic on the eastbound freeway lanes. The line continues within the median in an easterly direction until east of the Willow Pass Road interchange where it transitions into subway to pass under the westbound lanes. Upon emerging from beneath the freeway, the line continues at-grade along the north side of SR-4 until it transitions to aerial structure as it pulls away from the on-ramp from Willow Pass Road.

Though construction work has commenced on the improvement of SR-4 to a six lane facility from west of Port Chicago Highway West to an interchange with Willow Pass Road, construction of the remaining section from the top of the pass to the existing freeway in West Pittsburg is presently scheduled to be done after 1980. For the purposes of this report, it is assumed that the freeway through this section will be complete with a wide median. This means that it will be necessary to shift the westbound lanes on the east side of Willow Pass when the BART extension is made in order to create the needed space for the at-grade configuration north of the freeway.

The aerial line then curves to the northeast and crosses over the intersection of Port Chicago Highway and Willow Pass Road into the West Pittsburg Station. Leaving this station the line passes over the Southern Pacific Transportation Company and the Atchison, Topeka and Santa Fe Railroad, then



NATURAL RESOURCE IMPACTS

	zone aa	zone bb	zone cc	zone dd
Biological Resources	None	None	None	None
Hazards	None	None	None	Slope Hazards-Moderate Failure
Agricultural & Water Resources	None	None	Other Productive Areas 200' R	Prime Soil Areas Ground Water Quality & Quantity
Visual & Recreation Resources	None	None	None	Public Agency Lands-Physical Destruction

COMMUNITY IMPACTS

Noise Impacts
Relocation Impacts

zone aa

Noise

Distance from BART	Houses	Apts.	Schools	Parks	Hospitals
100'	3	-	-	1	-
200'	20	-	-	-	-
300'	8	-	1	-	1
500'	26	2	-	-	-

Relocation

Houses	Apts.	Businesses
12	4	2

zone bb

Noise

Distance from BART	Houses	Apts.	Schools	Parks	Hospitals
100'	153	1	-	-	-
200'	131	5	-	-	-
300'	126	3	-	-	-
500'	189	3	-	-	-

Relocation

None

zone cc

Noise

Distance from BART	Houses	Apts.	Schools	Parks	Hospitals
100'	3	-	-	1	-
200'	2C	-	-	-	-
300'	8	-	1	-	1
500'	26	2	-	-	-

Relocation

None

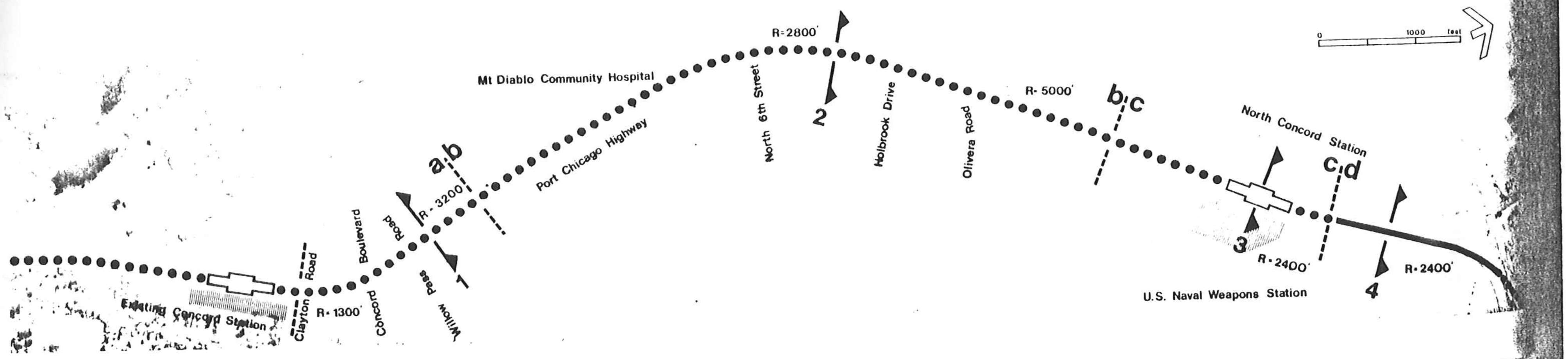
zone dd

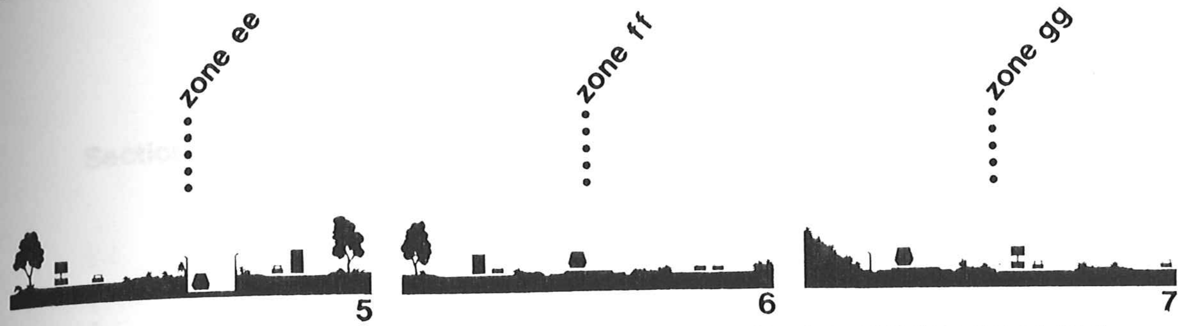
Noise

Distance from BART	Houses
100'	-
200'	-
300'	11
500'	9

Relocation

None





Legend

N - New Impacts

R - Reinforces Existing Impacts

None	
Seismic Hazards-High Seismic Response	200' N
Prime Soil Areas	600' N
None	

Noise

None

Relocation

None

Critical Wildlife Habitats-Physical Destruction	1000' N 3000' R
Slope Hazards-Moderate Failure	1200' N 2200' R
Seismic Hazards-High Seismic Response	100' N 1600' R
Prime Soil Areas	1800' N 6000' R
Other Productive Areas	300' R
Ground Water Quality & Quantity	3500' R
Public Agency Lands-Physical Destruction	2500' N 6000' R
Visually Prominent Open Space Zone	1200' N 2000' R

Noise

Distance from BART	Houses	Apts.	Schools	Parks	Hospital's
100'	3	-	[illegible]	1	-
200'	20	-	-	-	-
300'	8	-	1	-	1
500'	26	2	-	-	-

Relocation

None

Critical Wildlife Habitats-Physical Destruction	1900' R
Alter Subsurface Hydrologic Condition	2500' R
Slope Hazards-Moderate Failure	3000' R
Seismic Hazards-High Seismic Response	800' R
Other Productive Areas	2000' R
Ground Water Quality & Quantity	2500' R
Public Agency Lands-Physical Destruction	3500' R

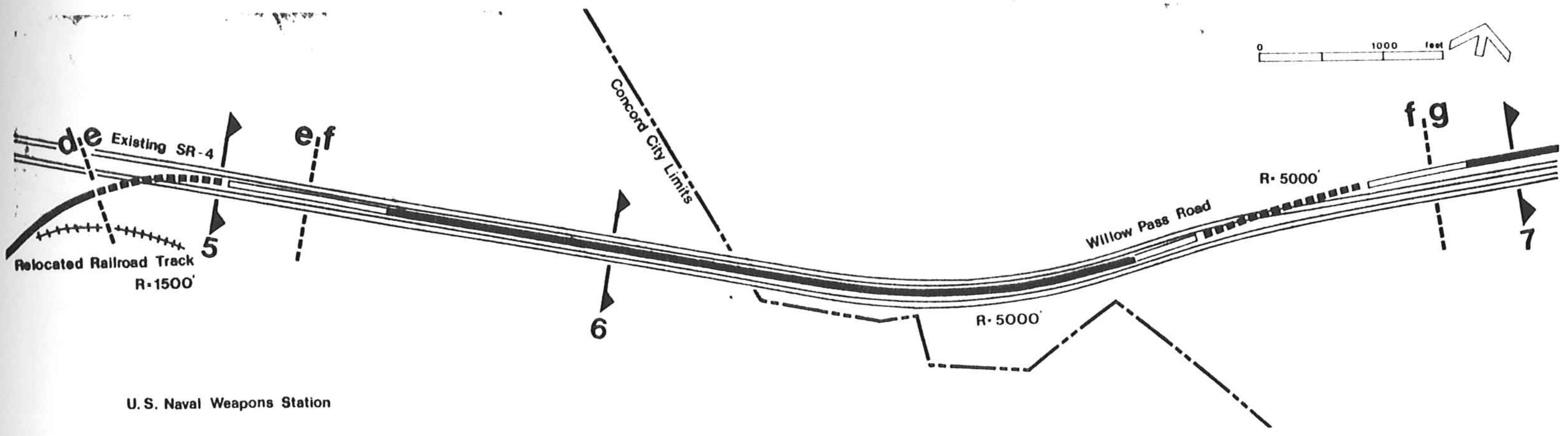
Noise

Distance from BART	houses
100'	
200'	2
300'	1

Relocation

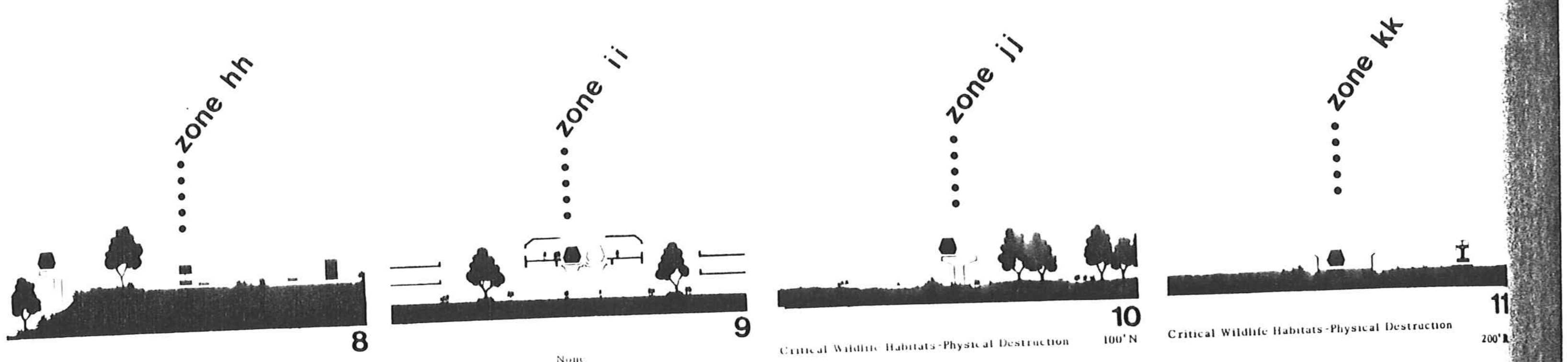
None

Figure 5-1. BART Alignment from Concord to Willow Pass



Zone Boundary	- - - a|b
Typical Section	▶
Surface Alignment	▬
Transition Zone	═
Aerial Alignment	●●●●
BART Parking	▨
BART Station	⬌

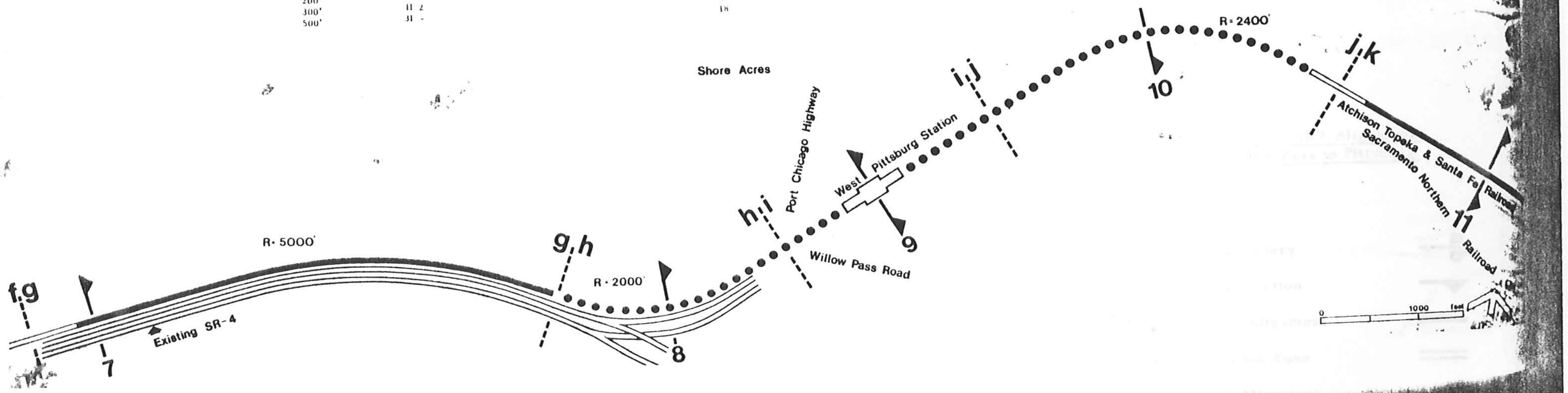
Section

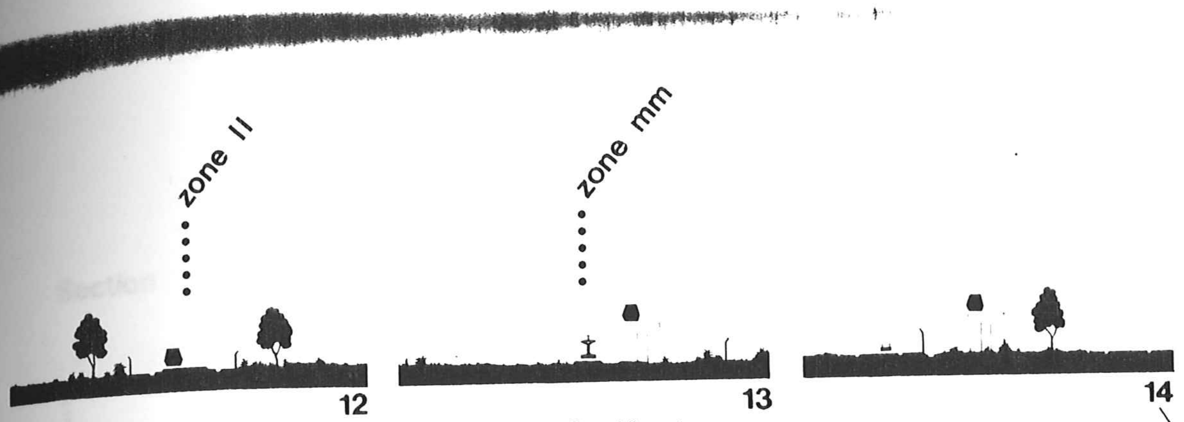


NATURAL RESOURCE IMPACTS

COMMUNITY IMPACTS

	8		9		10		11	
Biological Resources	Critical Wildlife Habitats-Physical Destruction Critical Plant Communities-Physical Destruction	500' R 1200' R	None		Critical Wildlife Habitats-Physical Destruction	100' N	Critical Wildlife Habitats-Physical Destruction Alter Subsurface Hydrologic Condition	200' R 2000' N
Hazards	Slope Hazards-Moderate Failure	1300' R	None		Seismic Hazards-High Seismic Response Flood Hazards-Flood Prone Areas	1500' N 800' R 900' R	Seismic Hazards-High Seismic Response Flood Hazards-Flood Prone Areas	3500' R 2100' R
Agricultural & Water Resources	Ground Water Quality & Quantity	500' R	Other Productive Areas	500' N	Other Productive Areas Ground Water Quality & Quantity	2000' N 1000' R	Ground Water Quality & Quantity	2000' N 3000' R
Visual & Recreation Resources	Public Agency Lands-Physical Destruction	2500' N 400' R	Public Agency Lands-Physical Destruction	3000' N	Public Agency Lands-Physical Destruction	2500' N 500' R	Public Agency Lands-Physical Destruction	3100' R
Noise Impacts Relocation Impacts	Noise	Relocation	Noise	Relocation	Noise	Relocation	Noise	Relocation
	Distance from BART / Houses / Apts. 100' 1 - 200' 7 - 300' 11 2 500' 31 -	Homes 1	Distance from BART / Houses 100' - 200' - 300' 5 500' 18	None	None	None	None	None





12		13		14
Critical Wildlife Habitats-Physical Destruction	5000' N	Critical Wildlife Habitats-Physical Destruction	1200' R	→
				→
Seismic Hazards-High Seismic Response	3100' N	Seismic Hazards-High Seismic Response	2500' R	
Flood Hazards-Flood Prone Areas	2100' N			→
Other Productive Areas	1200' N			
Ground Water Quality & Quantity	7000' N	Ground Water Quality & Quantity	1000' N	
		Public Agency Lands-Physical Destruction	1500' R	→
Noise Intrusion of Proposed Recreation Lands	6700' N			→

Section 12:

Noise: None

Relocation: None

Section 13:

Noise

Distance from BART	Houses	Apts.
100'	6	-
200'	9	1
300'	14	-
500'	24	-

Relocation: None

Legend

N = New Impacts

R = Reinforces Existing Impacts

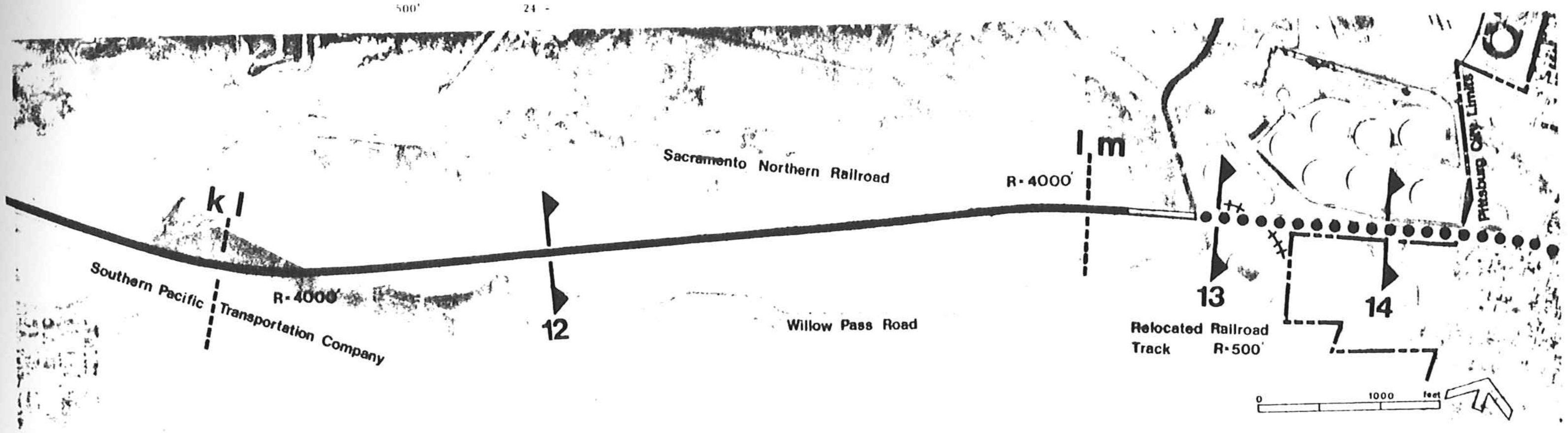
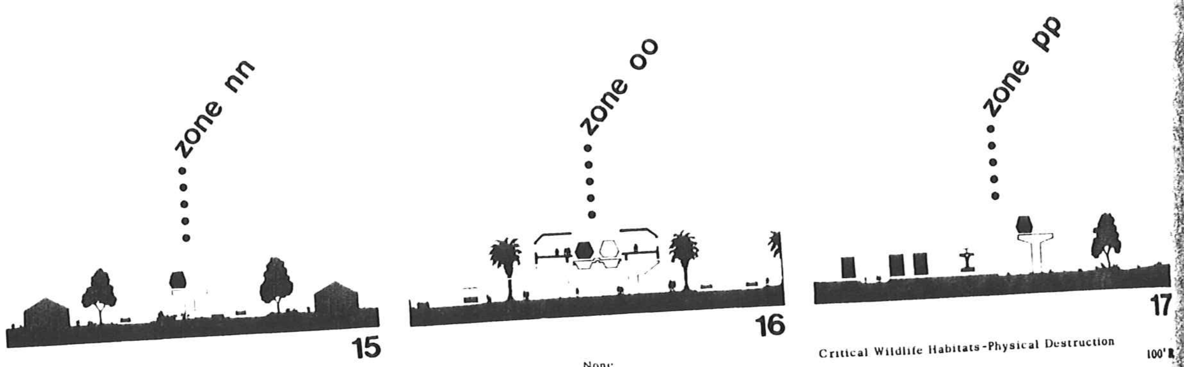


Figure 5-2. BART Alignment from Willow Pass to Pittsburg

Zone Boundary	- - - a¦b
Typical Section	▶
Surface Alignment	▬
Transition Zone	═
Aerial Alignment	● ● ● ●
BART Parking	▥
BART Station	⬭



Section

NATURAL RESOURCE IMPACTS

Biological Resources

Hazards

Agricultural & Water Resources

COMMUNITY IMPACTS

Noise Impacts
Relocation Impacts

None

Seismic Hazards-High Seismic Response 450' R

None

None

Noise

Distance from BART	Houses	Apts.
100'	45	1
200'	35	2
300'	46	2
500'	59	4

Relocation

None

None

None

None

None

Noise

Distance from BART	Houses	Apts.	Schools	Parks	Hospitals	Churches
100'	38	-	1	-	-	1
200'	34	-	-	-	-	-
300'	55	-	-	-	-	-
500'	30	-	-	-	-	-

Relocation	Homes	Apts.	Business
	30	1	1

Critical Wildlife Habitats-Physical Destruction 100' R

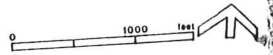
None

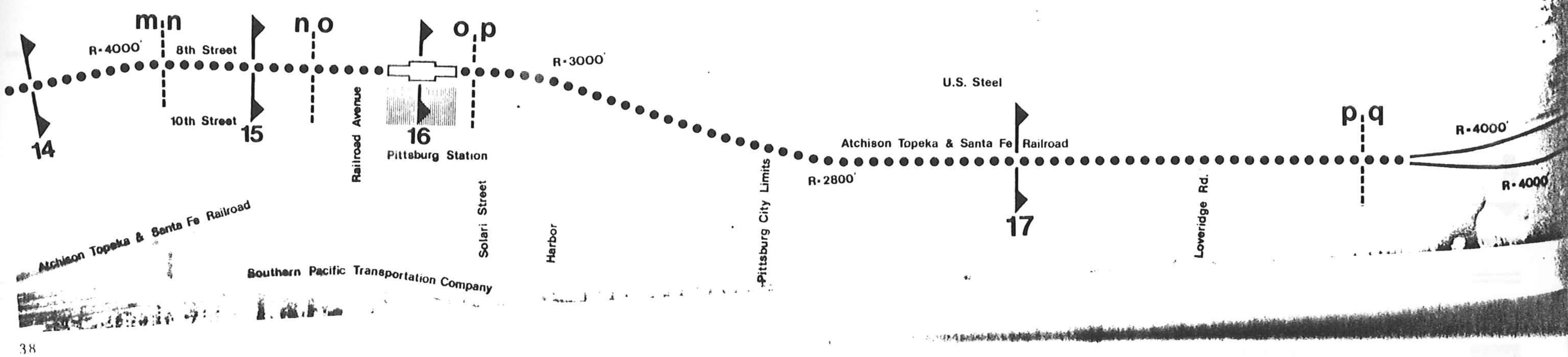
None

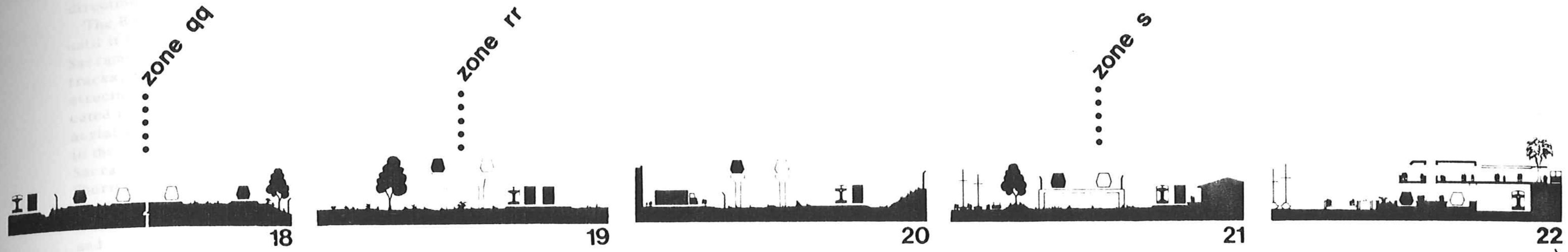
None

Distance from BART	Houses	Apts.	Schools	Hospitals
100'	13	15		
200'				
300'				
500'				

None







Critical Wildlife Habitats-Physical Destruction 1000' N 200' R

Critical Plant Communities-Physical Destruction 500' R

Seismic Hazards-High Seismic Response 2000' N 1000' R

Flood Hazards-Flood Prone Areas 2500' N 2000' R

Prime Soil Areas 1800' N 2000' R

Ground Water Quality & Quantity 4500' N

None

Noise None

Relocation None

Critical Wildlife Habitats-Physical Destruction 350' R

Seismic Hazards-High Seismic Response 2200' R

Flood Hazards-Flood Prone Areas 3000' R

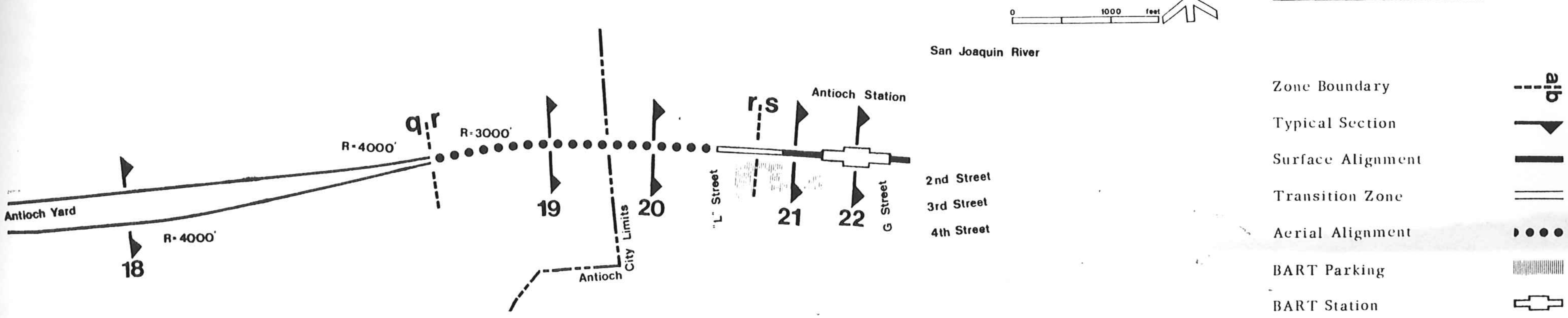
None

None

Noise None

Relocation relocated cannery facility

Figure 5-3. BART Alignment from Pittsburg to Antioch



descends to grade to parallel the tracks. After passing over the Sacramento Northern Railroad, the line turns in a northeasterly direction along Willow Creek.

The BART line remains at-grade until it begins to parallel the Sacramento Northern Railroad tracks, then ascends to aerial structure to pass over the relocated track. From this point the aerial line continues to the east in the soon-to-be abandoned Sacramento Northern right-of-way. Shortly after passing through the outskirts of the City of Pittsburg, it enters the median of 8th Street and continues into the aerial Pittsburg Station located between Cumberland and East Streets.

Pittsburg to Antioch

East of the station the line continues in the median of 8th Street, crosses Harbor, and enters U.S. Steel property on aerial structure. The line curves to the southeast, passes over the Atchison Topeka and Santa Fe Railroad tracks and yard on a double-column bent structure, and continues to the east along the south side of the tracks. After crossing over Loveridge Road and the last Atchison, Topeka and Santa Fe spur just to the east, it descends to at-grade and the two BART tracks diverge to allow space between them for a storage and maintenance yard. Details of the yard layout are contained in Section 7.

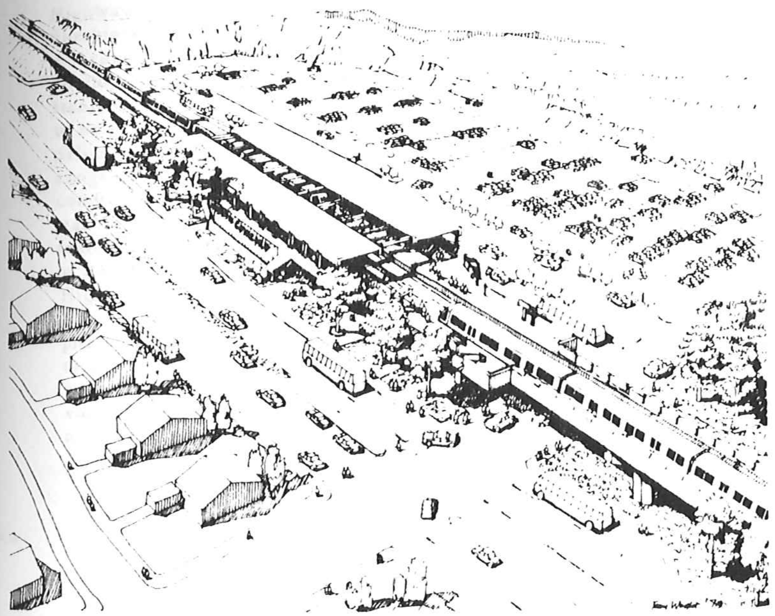
The split BART tracks remain at-grade along the south side of the Atchison, Topeka and Santa Fe tracks until just west of the Fibreboard Plant in Antioch, where they come closer together and ascend to an aerial structure in order to pass over the AT&SF tracks. Having crossed over the railroad on a double-column bent structure, the line continues easterly along the north side of the tracks on a wide aerial structure until just beyond the cannery. At this point it descends to at-grade and enters the Antioch Station which is located between "G" and "I" Streets. This center platform station and two hundred feet of extra track beyond it, required for safety measures, represent the end of the extension.

North Concord Station

ok

The proposed North Concord Station is located east of Port Chicago Highway on undeveloped land belonging to the U.S. Naval Weapons Station. A layout of the station, parking areas, and adjacent local streets are shown in Figure 5-4. For general descriptive purposes, it can be said to lie between Sun View Terrace and Panoramic Way.

This station will provide BART patrons living in North Central Concord with the option of avoiding congestion at the central Concord Station. It will also directly serve North Concord residential areas as well as patrons living in North Martinez.



Kiss-Ride Facilities

To help reduce possible conflict with the northbound traffic flow along Port Chicago Highway, the kiss-ride and bus parking areas are separated from this major arterial and located along a one-way access road just to the east of the station structure. Also, most of the BART-related traffic movements in and out of the lot will occur at the access point opposite the proposed signalized intersection of Sun View Terrace and Port Chicago Highway. This allows those kiss-ride vehicles and buses which originate from and must return to the south to make a loop within the parking lot and leave via the above exit.

Space will be allotted to the station for 20 to 25 kiss-ride stalls and 3 to 6 bus pads. In addition, the configuration of the present curb line along the west side of Port Chicago versus the final alignment for the four-lane, divided facility allows space to be provided for both southbound buses and kiss-ride vehicles which do not wish to reverse their direction.

Park-and-Ride Lot

The park-and-ride lot will provide spaces for approximately 500 park-and-ride vehicles. It has one major access point along Port Chicago Highway which is located opposite the highway intersection of Sun View Terrace. An additional point of egress is provided for northbound traffic at the north edge of the lot.

Pedestrian Access

Pedestrian access from existing residential areas west and south of the BART station is potentially good. For the neighborhood to the south, pedestrian linkage could be developed either along Port Chicago Highway or through the recreation area on the southerly boundary of the parking lot. Access for pedestrians coming from west of Port Chicago Highway or from the drop-off zone previously mentioned, would be via an at-grade pedestrian crossing located at the proposed signalized intersection of Sun View Terrace and the highway. In addition, walking distances for all BART users arriving at the lot via a vehicle will be short. The distance from the most removed park-ride stall is only 600 feet.

Automobile Access-Circulation Plan

All vehicular access to and from the North Concord Station will be via Port Chicago Highway as is shown in Figure 5-6, the Circulation Plan. This street, which is presently a two-lane arterial, is soon to be widened to a divided, four-lane facility just north of the station site as part of the reconstruction of the Port

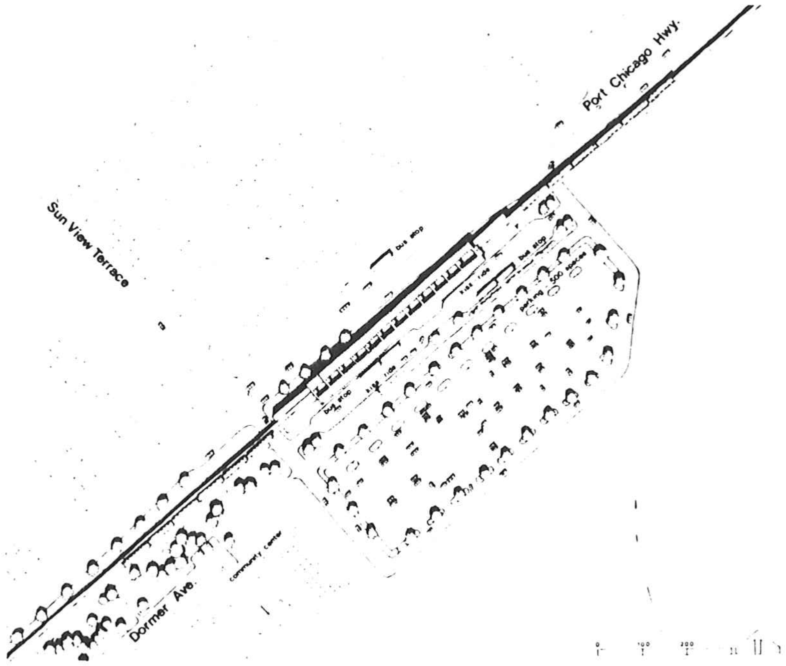
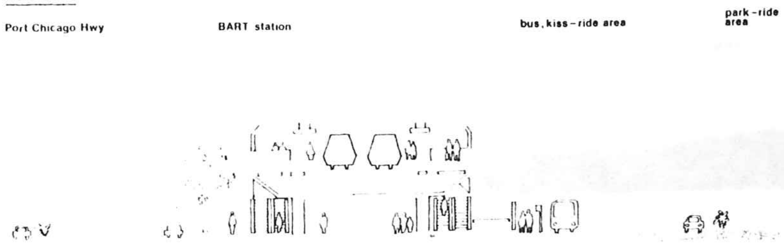


Figure 5-4. North Concord Station and Parking Lot Plan

Figure 5-5. Typical Station Cross Section



Chicago Highway interchange with State Route 4 and the improvement of that route into a six-lane freeway. In addition, the widening of Port Chicago Highway into four lanes with a median will be extended to the south at the time of the BART extension.

The majority of BART-generated traffic will come from the north, and mainly from Martinez. While many of these BART users now travel to the Concord and Pleasant Hill Stations, they will find the North Concord Station easier to get to due to its proximity to the freeway and the absence of somewhat congested downtown traffic. Based on existing development in the Clyde and Port Chicago areas, little patronage is expected from that vicinity. If non-naval oriented development occurs in Port Chicago after the extension is built, the patronage from that direction will increase appreciably. The number of passengers coming from the area south of the North Concord Station will depend on the convenience of these two stations to the residential areas as they evolve through Concord's redevelopment efforts.

When traffic to the station which is located near the Port Chicago Highway interchange with SR-4 was combined with a predicted 1990 Average Daily Traffic Flow of 20,000 vehicles on the highway (4) itself, special consideration had to be given to prevent BART-oriented traffic from causing congestion and unsafe driving conditions for freeway users. It was therefore decided to concentrate all left-hand turn movements of BART traffic across Port Chicago Highway at the Sun View Terrace intersection and install a three phase signal system at that location to regulate traffic flow. Based on morning peak hour left-turn traffic volumes for southbound vehicles of no more than 200 into the BART lot, it was determined that the signal phasing would not impede traffic flow on Port Chicago Highway. Adequate vehicle storage capacity could be provided in the highway median. During the evening peak hour, the time allotted to each phase could be readjusted since the majority of BART traffic at that time will be making right hand turns out of the two exits.

Bus Feeder Service

Though Greyhound now provides some inter-city bus service in Concord, there is a possibility that it may soon be eliminated due to the affect of the existing BART system on Greyhound's patronage between Concord and the cities on the Bay. However, BART initiated express bus service from Martinez, Antioch and Pittsburg to the Concord Station in late 1974. At the time that the BART extension would go into operation, this express service would be eliminated except for the lines from Martinez which should be rerouted to deliver passengers to this station. Additional local service in the area was studied by the Local Mass Transportation Agency of Contra Costa County but this plan was defeated by the voters in the 1974 November election.

Area Description

Most of the land surrounding the station site is developed, with older single family housing on either side of Port Chicago Highway, and with a new subdivision located directly opposite the station on Sun View Terrace. Land to the south and east of the station is owned and used by the U.S. Naval Weapons Station as an underground storage facility area. For existing and planned land uses in the vicinity

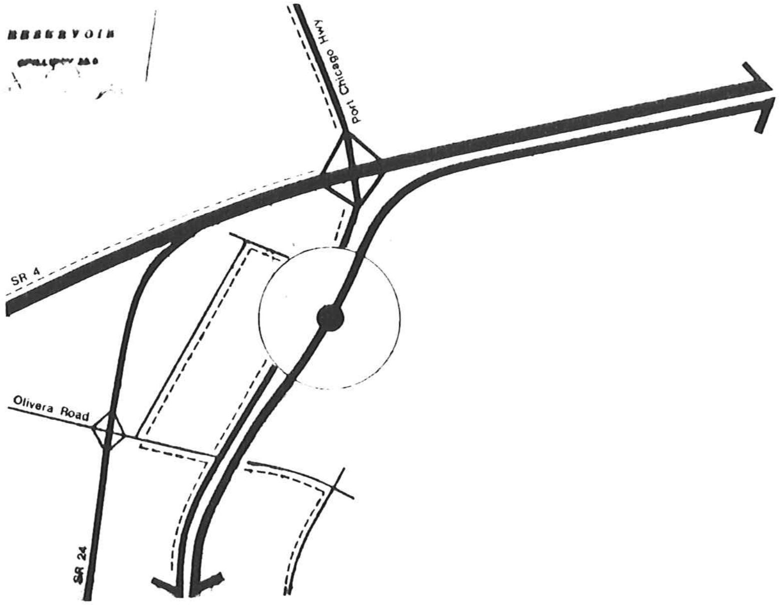


Figure 5-6. North Concord Station Circulation Plan

- ▬ Freeway
- ━ Major Arterial Street
- ─ Collector Street
- ● BART Station
- ⟷ BART Route
- ---- Feeder Bus
- ○ 1/4 Mile Walking Distance

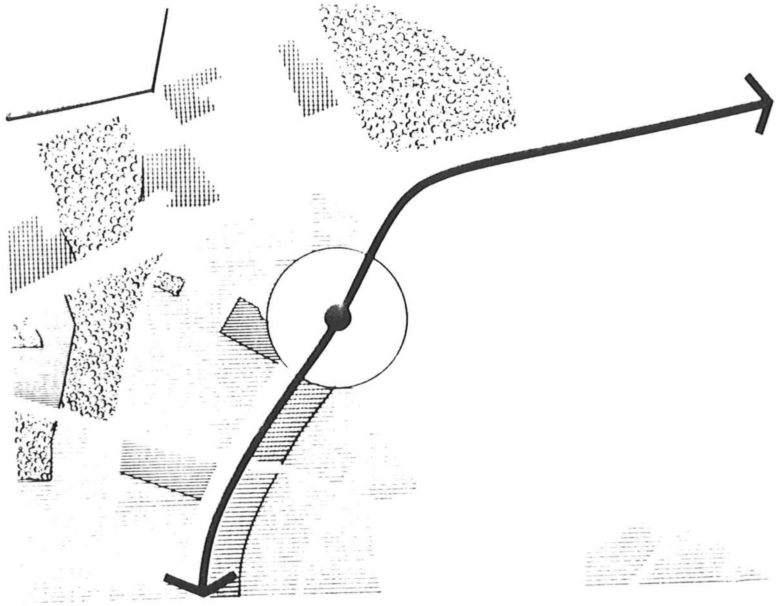


Figure 5-7. North Concord Land Use Plan

Existing

- ▤ Activity Center
- ▤ Multi-family Residential
- ▤ Single family Residential
- ▥ Industrial
- ▩ Parks and Open Space

Planned

- ■ Activity Center
- Multi-family Residential
- Single family Residential
- ▦ Industrial
- ▩ Parks and Open Space

of the station see Figure 5-7.

STATION AREA DEVELOPMENT POTENTIALS

If the U.S. Naval Weapons Station properties are abandoned, this land, which is within the City of Concord, could become available for development. South facing slopes with excellent views of Mt. Diablo offer possibilities for well planned residential areas linked by pedestrian and bicycle ways to the BART station. Access to these areas could either be from Blois Avenue off Willow Pass Road or from Hamilton Avenue off East Olivera Road. It is anticipated that older residential properties adjacent to the BART line along Port Chicago Highway will, at some future time, be replaced by high density housing and apartments which could be designed and located so as to minimize BART noise impacts for residents. Future commercial development should be limited to the neighborhood store or local convenience shop located close to the BART station and within easy walking distance of existing and possible new residential areas. (See Figure 5-8).

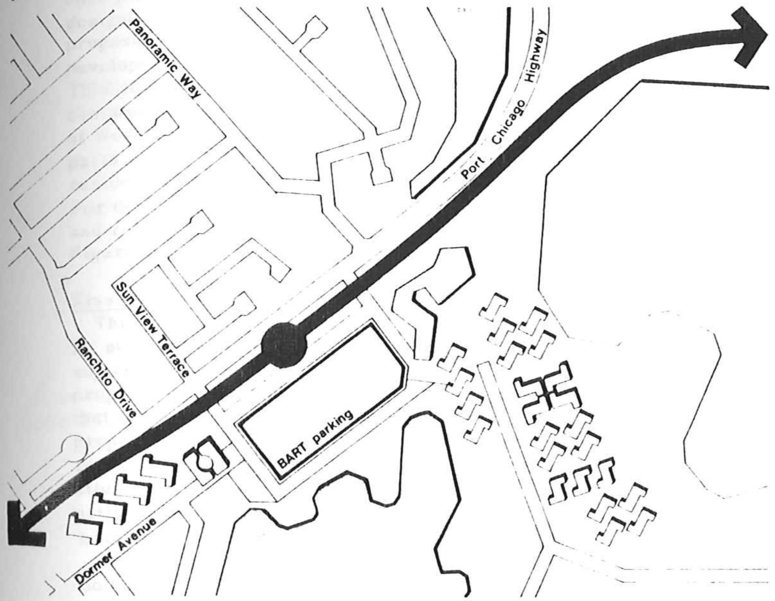


Figure 5-8. North Concord Station Area Development Concept

▨ Open space and Major land forms

Medium density housing 5-25 d.u./acre

Community facility

● BART station

⟷ BART route

d.u./acre = Dwelling units per acre

Alternative Station Location

In the event that the U.S. Naval Weapons Station is abandoned, an alternative route could follow Port Chicago Highway with a station either at Clyde or Port Chicago. If the station is located at Port Chicago, it would not necessarily eliminate the North Concord Station. However, its elimination would be probable in light of the short station spacings that would then exist relative to the Concord Station.

Interest in development of a water-oriented new town at Port Chicago is presently receiving considerable attention. A report prepared by the Citizens Committee for the Weapons Station Conversion presents a case for conversion of the U.S. Naval Weapons Station properties to public and private use featuring redevelopment of the Port Chicago to a self-contained new community of some 17,000 people. However, the Weapons Station is presently developing containerization facilities which could, in the event of the Station being phased out, result in the development of extensive port facilities which could utilize the deep water handling capabilities at Port Chicago. This would further necessitate a tie-in with BART since such activity would create a large employment center.

West Pittsburg Station

The BART line crosses the Port Chicago Highway, Willow Pass Road intersection on aerial structure diagonally bisecting the Shell Oil properties located between the Atchison Topeka and Santa Fe Railroad tracks and Willow Pass Road.

The aerial station will be located approximately 900 feet from the intersection. An at-grade concourse would connect to an open plaza within a shopping center designed as the focal point of the proposed new community to be developed on the Shell properties. This station would serve this new community, adjacent neighborhoods of West Pittsburg, Port Chicago, parts of Pittsburg and close-by residential areas south of SR-4. For details of the station location and related parking areas, see Figure 5-9.

Kiss-Ride Facilities

The fact that the BART parking lot at this station is to be built adjacent to the parking area for a proposed shopping center, and that the station structure itself is proposed to be integrated with the retail complex, have created a situation where kiss-ride activities for users of both facilities have much in common.

Drop-off zones are required for both BART and shopping center users who are brought to the area in private vehicles and will be picked up when they have returned from work, completed their shopping, or finish whatever activity has attracted them to this location. Very often shoppers will drop-off some of the passengers in their cars before finding a parking stall. When the time has come to pick up the returning BART passengers or shoppers who are in the same situation, or those who possibly have too many packages to carry to the car, convenient and ample temporary parking space must be located as close as possible to the BART station and the store. Therefore, the road running along the south and west sides of the transportation-shopping complex would be used mainly for these activities. Of the stalls placed along both sides of this road, thirty auto stalls would be for BART users, together with two to four bus pads.

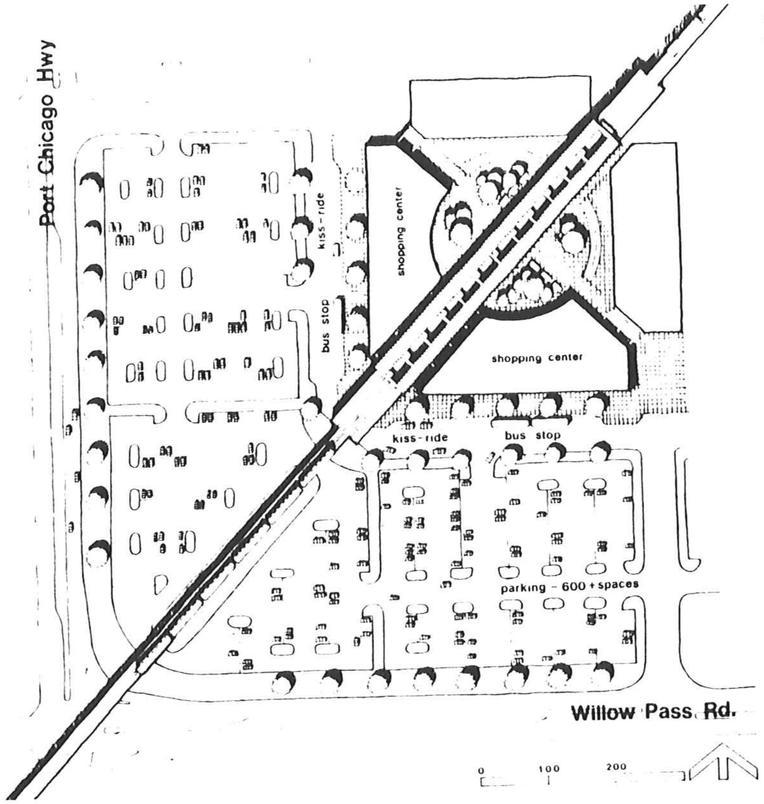


Figure 5-9. West Pittsburg Station and Parking Lot Plan

Park-and-Ride Lot

Similar to the kiss-ride areas, the park-and-ride stalls for BART patrons are situated adjacent to those for shopping center users. The BART stalls totalling approximately 200, are located along both sides of the aerial structure and are as close as possible to the station. Access to and from the park-and-ride areas is via Port Chicago Highway and Willow Pass Road. To separate park-and-ride vehicles from kiss-and-ride traffic, there is an internal access road for their use which passes through the shopping center parking lot. This road will be used by shoppers also, but there should be little conflict due to the small number of cars that may be entering or leaving the lots at the same time.

Pedestrian Access

Pedestrian access from existing residential areas west and south of the BART station would be facilitated by two proposed signalized intersections at Port Chicago Road and Riverside Drive and Willow Pass Road and Alberts Avenue. People coming from the proposed new community located north-east of the station could bicycle or walk to BART along exclusive pathways. BART patrons arriving by car would have a maximum of 400 feet to walk. A large portion of this distance could be undercover dependent on how close they parked to the BART overhead structure.

Automobile Access- Circulation Plan

The parking lot for BART patrons using this station would be located adjacent to the intersection of Port Chicago Highway and Willow Pass Road, the two major arterials in the area. All of the existing residential development in West Pittsburg from which BART users will be attracted, including Shore Acres, or the undeveloped Shell Tract are located adjacent to one of these roads. A plan showing the more important local roads is shown in Figure 5-10.

Any additional improvements required to maintain smooth traffic can be determined when the amount of traffic generated by the proposed shopping center is calculated and superimposed with BART generated traffic. In addition, vehicular activity at the intersection of Port Chicago Highway and Willow Pass Road through which traffic traveling to and away from an improved SR-4 will pass, will increase if development occurs on the Shell properties. However, resultant traffic congestion which would hinder access to the BART station could be reduced by proper signalization and channelization at the intersection.

Bus Feeder Service

There are no present plans for bus service in West Pittsburg. However, at the time BART is extended to Antioch, service provided by BART "Express" buses could be restructured to provide service to the station. Furthermore, the existence of both the BART station and the proposed shopping center, together with any other related business development that might occur, could possibly justify creation of a demand-responsive or dial-a-ride service keyed to this major activity center.

Area Characteristics

West Pittsburg is located in an unincorporated area of the County, at the foot of Willow Pass and west of the City of Pittsburg. Immediate neighborhood areas are comprised of low and middle income single family detached and semi-detached homes. Recent developments west of Port Chicago Highway include conventional subdivisions and mobile home communities and scattered commercial uses along Willow Pass Road. Much of the housing in the area appears to be well maintained and is between 2-5 years old. Convenience shopping is nearby on Port Chicago Highway and there is easy access to yacht harbors across the Atchison, Topeka and Santa Fe Railroad tracks on Suisun Bay. For existing and planned land uses in the West Pittsburg area refer to Figure 5-11.

STATION AREA DEVELOPMENT POTENTIALS

This report proposed that the BART station become the focus for a new community located on the 230 acre parcel presently owned by Shell Oil. Though this parcel is presently zoned industrial, Shell real estate division is presently considering resale to a developer for residential use. As proposed, the development could offer a range of housing types with ample community open space, a community center with recreation facilities, and a shopping center integrated with the BART station. Details of this concept are contained in Figure 5-12.

The following set of proposals should be regarded as the ingredients of a conceptual plan which could form the basis of a set of development guidelines for the site irrespective of whether development of the BART line and station proceeds.

Design Framework

The BART station would be located in a shopping center designed to serve the entire community of West Pittsburg. Housing would be organized on either side of the BART line with progressively lower densities radiating out from the station itself. Pedestrian circulation would follow a linear parkway under and adjacent to the BART line. This would constitute the main pedestrian spine for the community with a series of radiating pedestrian paths and beltways providing direct access to and separation between various densities of housing. Automobile circulation would be limited to a peripheral road with spur roads to service housing areas where necessary.

Shopping Center

Market research developed during this project indicates a warranted demand for approximately 600,000 square feet of commercial space in the West Pittsburg area by 1990. A large percent of this demand could be accommodated within this development dependent on shopping center development interests and operating requirements. The center could include:

1) Automobile and mass transit oriented commercial catering to a sub-regional market featuring a major food chain, drugs and household goods.

2) Small scale commercial operations, including restaurants, cafes, boutiques, appliance and food shops, and perhaps a small theater catering to local needs.

These shops, together with various professional and service offices, such as medical-dental services, real estate and health care facilities could be situated around a landscaped square which would act as both a community meeting place and a pedestrian plaza for people walking to and from the BART station.

Housing

Although housing could accommodate various age groups or lifestyles, this particular development would be most appealing to families who prefer close-at-hand shopping and

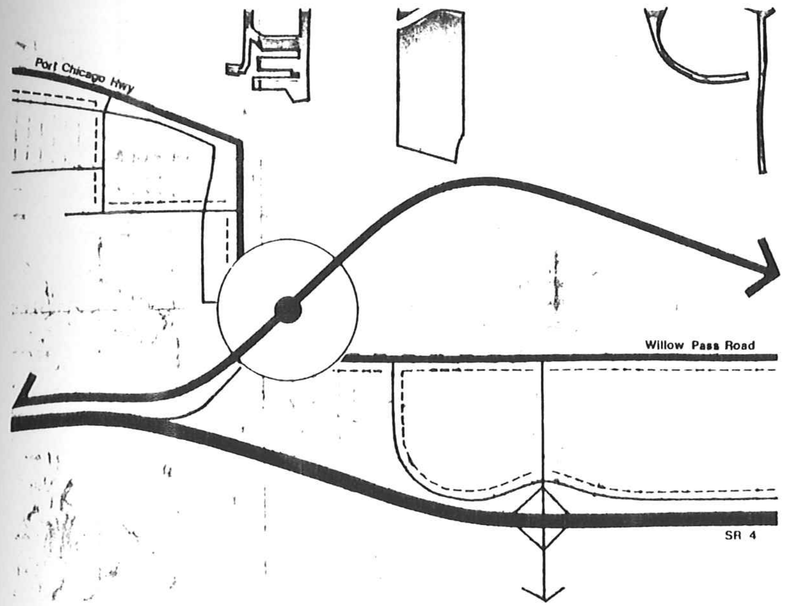


Figure 5-10. West Pittsburg Station Circulation Plan

- ▬ Freeway
- ▬ Major Arterial Street
- — Collector Street
- ● BART Station
- ⟷ BART Route
- ---- Feeder Bus
- ○ Walking Distance

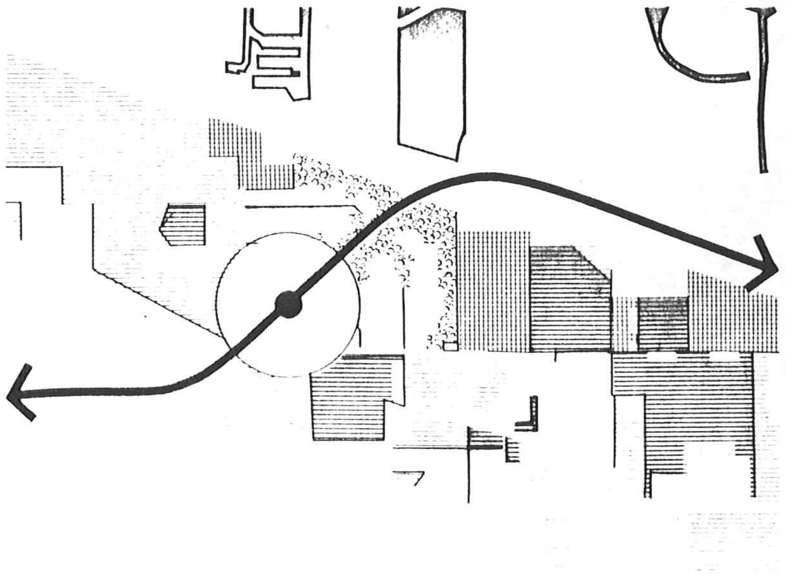


Figure 5-11. West Pittsburg Land Use Plan

Existing	Planned
▤ Activity Center	■ Activity Center
Multi-family Residential	Multi-family Residential
Single family Residential	Single family Residential
▥ Industrial	Industrial
⁘ Parks and Open Space	⁘ Parks and Open Space

recreational activities. Various types, densities, and price ranges would be possible with higher density terraced apartments located close to the BART station and shopping center. Beyond these apartments a band of clustered multiple unit houses and modular apartments could be situated, separated by a beltway from an outer band of town houses. On the other side of the main feeder road opportunity would exist for construction of more conventional detached single family housing. All residences, with the exception of those units, would be within 1/4 miles of walking distance of the BART station.

Conservative estimates indicate that with BART a market demand would exist well in excess of the proposals made here. For example, there would be a potential demand for about 6,000 multiple units and 1,200 single housing units in West Pittsburg by 1990.

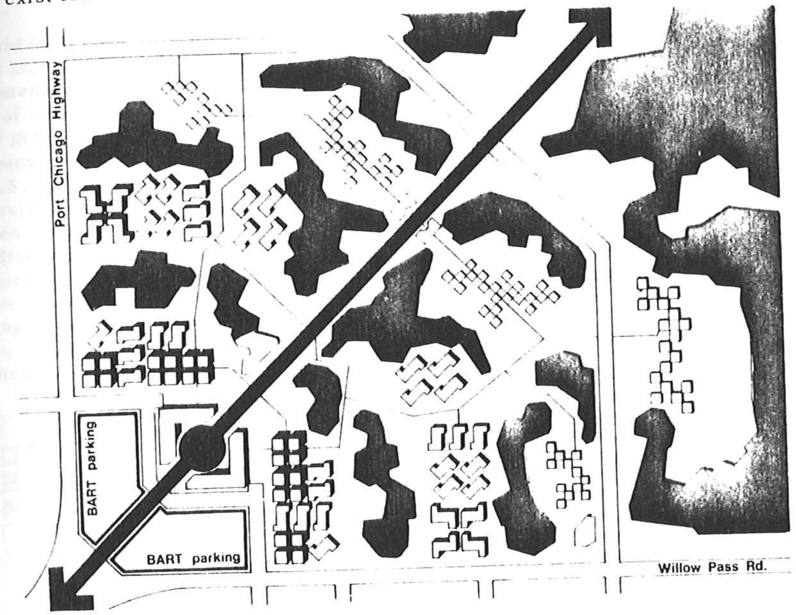


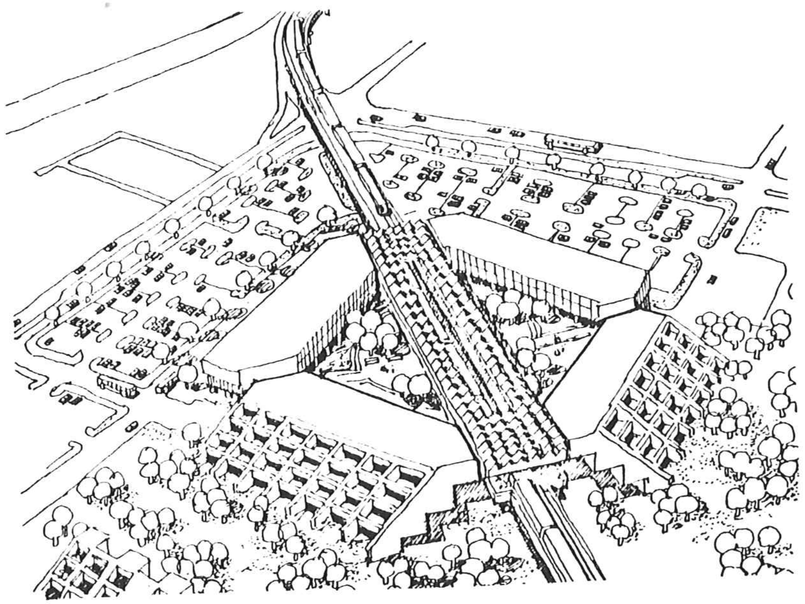
Figure 5-12. West Pittsburg Station Area Development Concept

- ■ Open space and Major land forms
- Retail commercial
- High density housing + 25 d.u./acre
- Medium density housing 5-25 d.u./acre
- Low density housing .0-5 d.u./acre
- Community facility
- ● BART station
- ←→ BART route

d.u./acre = Dwelling units per acre

Community Facilities

One or two community centers could be located along the main pedestrian spine adjacent to the BART structure. These centers, within short walking distance from any house, could provide a variety of functions and recreation, social and outdoor activities, including swimming pools, tennis courts, workshops, a daycare center, and a range of social and club activities.



Open Space Plan

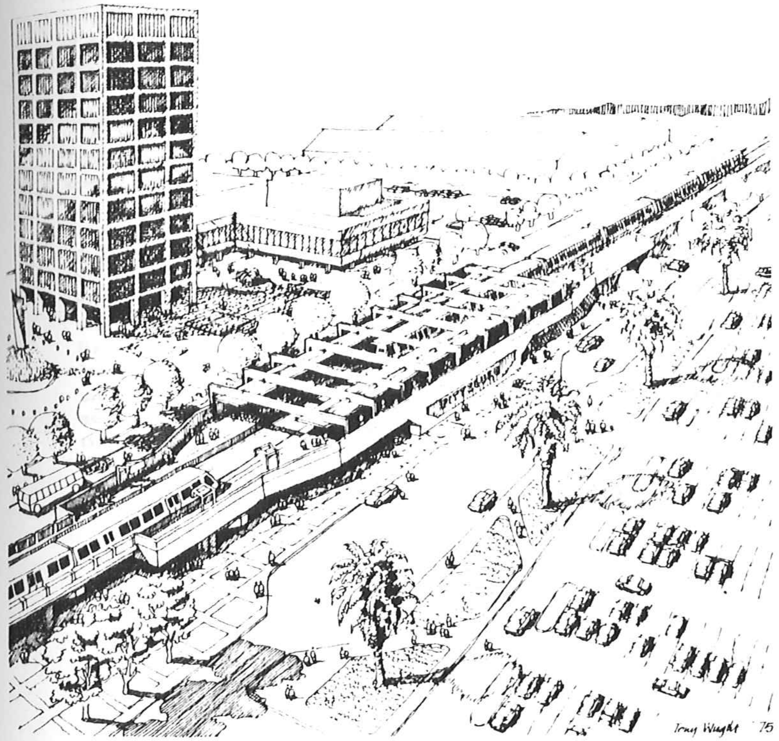
A substantial amount of land could be made available as permanent open space. Extensive berming and landscaping paralleling the aerial structure could help mitigate some of the adverse impacts of BART but proper housing orientation and design would be more effective. An integrated system of pedestrian and bicycle ways radiating out from the main station plaza and along the BART parkway would form the backbone for proposed development activity. A secondary network of pathways would wind through each beltway providing direct access to residences.

Automobile Circulation

Automobile access would be provided off Port Chicago Highway and Willow Pass Road on to a peripheral road with residential feeder streets reduced to a minimum.

Pittsburg Station

Rapid transit enters Pittsburg on aerial structure along the abandoned Sacramento Northern Railroad right-of-way. The line remains aerial through Pittsburg and continues on aerial structure over the U.S. Steel Corporation Plant. The station would be located between Cumberland Street and East Street with an at-grade concourse which could be designed as part of an open pedestrian plaza fronting onto Railroad Avenue. Station and parking area details are shown in Figure 5-13.



Kiss-Ride Facilities

Kiss-ride and bus pull-off areas are located on either side of the station. Though the station structure is located in the median of 8th Street, it is still possible to provide space for transit users and also to leave the existing east-west streets on each side of the median open to non-BART traffic. On the north side of the station this arrangement would permit access to private residences which might remain for some time. On the south side of the station, it would avoid creating any difficult vehicle movements on Cumberland, especially those related to the post office. With these streets remaining open to public use, there will be adequate space along them to develop stalls for approximately 50 kiss-ride vehicles and between 3 to 6 buses. This is the ideal location for these stalls because it locates them as close as possible to the station entrances and therefore encourages greater use of these modes.

None of the combined traffic movements predicted for either street will create traffic congestion and they are proposed to be two-way to facilitate movements generated by non-BART patrons and to further improve station accessibility.

Park-and-Ride Lot

The park-and-ride lot is located south of 8th Street and is bounded by East 8th Street on the north, East 10th Street on the south, Cumberland Street on the west, and East Street on the east. The property required for the lot consists of two blocks of older, small private residences, a little over a block of businesses, one church, and a large, older hotel.

The lot can provide stalls for approximately 550 vehicles and will have three access points; from Cumberland Street, from East Street opposite its intersection with East 9th Street, and East 10th Street opposite its intersection with Los Medanos Street. The walking distance from the stall located the farthest from the station itself is 750 feet which is considered acceptable.

Pedestrian Access

The median of 8th Street can be developed into a linear park with a pathway forming the major east-west pedestrian access into the station. This landscaped pathway could be extended west of Railroad Avenue. As mentioned previously, walking distances for persons arriving via kiss-ride or park-and-ride vehicles and buses is excellent.

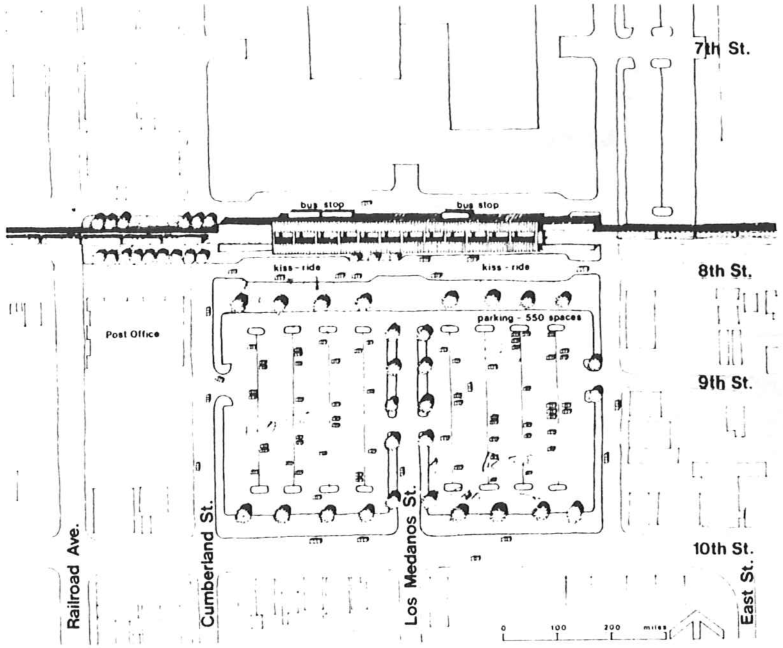
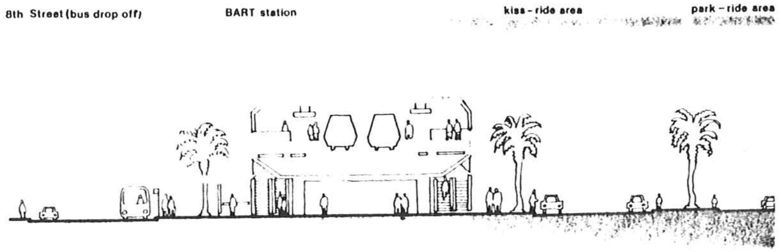


Figure 5-13. Pittsburg Station and Parking Lot Layout

Figure 5-14. Typical Station Cross Section



Automobile Access - Circulation Plan

The station is located a short distance from the intersection of Railroad Avenue and 10th Street, two major arterials in the central part of Pittsburg. The main east-west feeder, 10th Street, runs along the south side of the lot and provides good access in both directions. To the east this street connects with both Solari Street and Harbor. The lot is also one block east of Railroad Avenue which is the principal collector for the older areas to the north and for the expanding, newer areas of Pittsburg south of SR-4. To the south this street might present some minor access problems due to at-grade crossings over the SP and ATSF tracks. Principle access to the kiss-ride and bus load/unload areas off Railroad Avenue will be via East 10th Street and Cumberland Street. Furthermore, the existence of many lightly travelled residential streets permits relatively easy access from local neighborhoods. An overall plan of station oriented access is presented in Figure 5-15..

Bus Feeder Service

At the present time, the only bus service available to the residents of Pittsburg is Greyhound's inter-city service. This is presently being supplemented by the BART express bus program which provides service from Pittsburg to the Concord BART Station. There are, however, no firm plans for providing local feeder bus service when the extension is built. If no local bus service is in operation by that time, there would be a possibility that BART buses could be re-routed to provide feeder service to the Pittsburg BART Station.

As mentioned previously, the station has been situated and the parking lot sized to encourage heavy use of such service. If the area is to grow as predicted and the existing central business district becomes revitalized in terms of jobs and shopping, local transit could provide convenient intra-community transportation between the residential areas and these activity centers.

Area Characteristics

Older commercial/service establishments along Railroad Avenue tend to phase out as they approach the railroad crossing on 8th Street. Gas stations and drive-in eating establishments have traditionally located south of 8th Street. Marina School occupies 2 large blocks on the west side of Railroad Avenue. A new Post Office has recently been built on Railroad Avenue across from the railroad tracks. The smaller single family homes which extend between Cumberland Avenue and the U.S. Steel Corporation Plant are in various stages of dilapidation with the exception of two blocks of better maintained homes south of 8th Street.

An older substandard hotel, a small church, a few small single family homes, a boarded up bowling alley, and other various commercial service uses occupy two blocks bordering on 10th Street. Figure 5-16 summarizes both existing and potential future land uses for properties in the vicinity of the station.

STATION AREA DEVELOPMENT POTENTIALS

Residential Development: Pittsburg has a representative sampling of housing types, such as single family, multi-family, and mobile homes. By far the biggest category

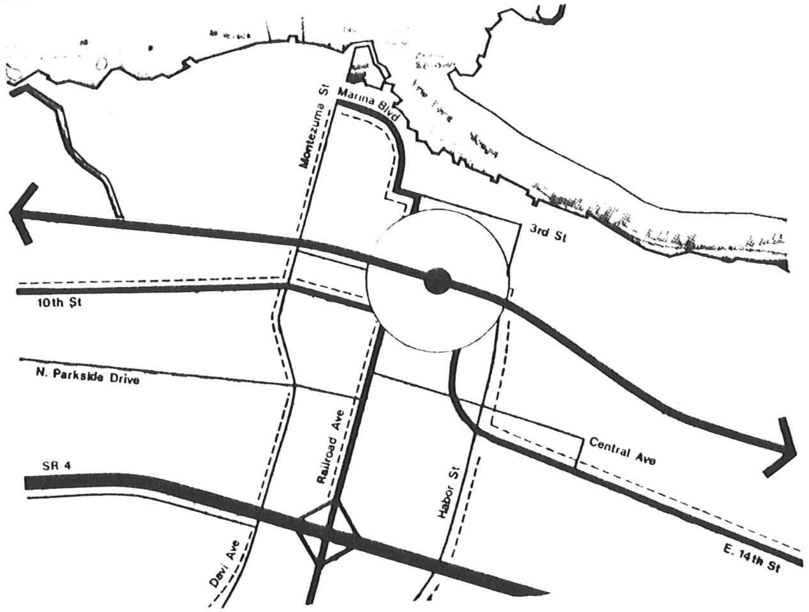


Figure 5-15. Pittsburg Station Circulation Plan

▬ Freeway

▬ Major Arterial Street

— Collector Street

● BART Station

⟷ BART Route

---- Feeder Bus

○ 1/4 mile Walking Distance

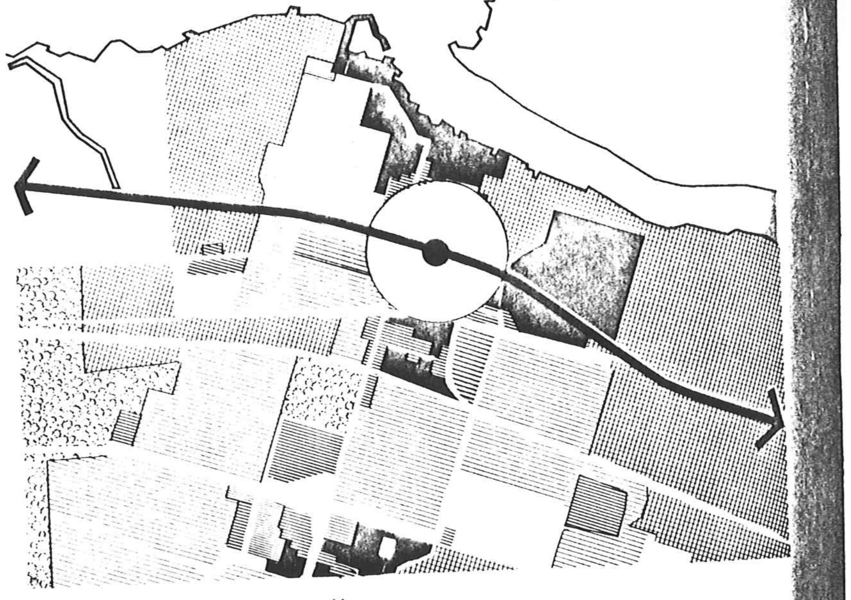


Figure 5-16. Pittsburg Land Use Plan

Existing

▤ Activity Center

▒ Multi-family Residential

░ Single family Residential

▥ Industrial

▩ Parks and Open Space

Planned

■ Activity Center

Multi-family Residential

Single family Residential

░ Industrial

▩ Parks and Open Space

is single family detached housing which represents almost 70% of the total housing stock. It is anticipated that with BART there would be an increased demand for multi-family housing and apartments.

Projections made during this study indicate that with BART, a practical demand for 4,460 new housing units in Pittsburg, north of SR-4 through 1974-1990. It is estimated that about 80% of this demand would be satisfied by multi-family housing. As the land around the BART station increases in value, conversion from single family to higher uses, principally office-commercial would result in further reducing the available supply of low cost housing. Property tax increases and speculation would cause many owners of an average $15,000 home to consider relocation, and use their increased equity as a major payment on a new $25,000 plus home in one of the newer corridor suburbs. However, for elderly persons of limited means who have paid off their mortgage, the situation would be more difficult. Also, low income persons who presently make up a majority of the city's renters who on an average pay less than $100 a month rent, would be most affected and would probably be forced to seek housing elsewhere, perhaps even outside the corridor area.

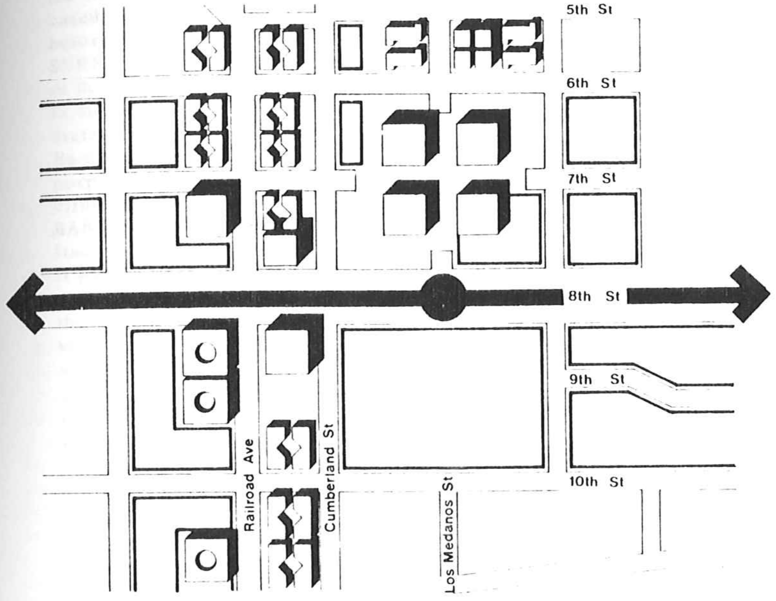


Figure 5-17. Pittsburg Station Area Development Concept

▢ Office commercial

▥ Retail commercial

⊞ High density housing + 25 d.u./acre

⊓ Medium density housing 5-25 d.u./acre

Ⓒ Civic/cultural facility

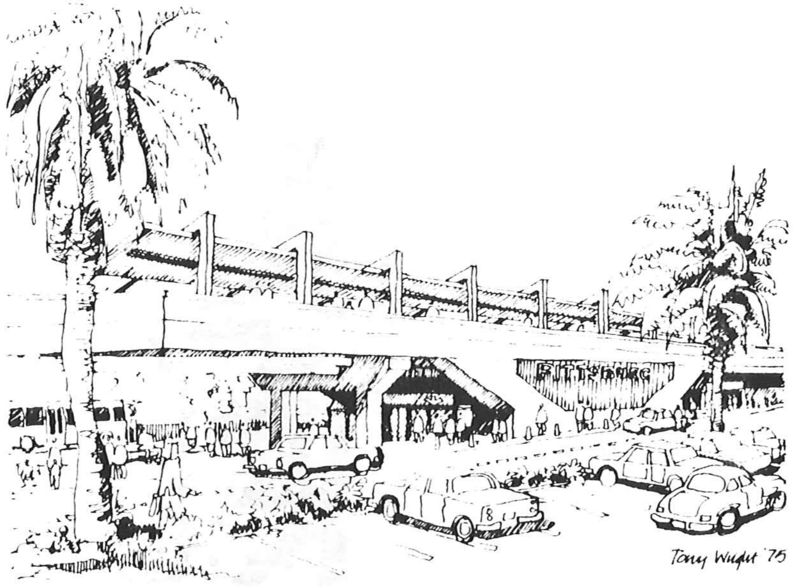
● BART station

⟷ BART route

d.u./acre = Dwelling units per acre

Office-Commercial Development: The central business district in the heart of Pittsburg's Model Neighborhood area lost its support with the end of the war boom; its principal commercial function today being that of a neighborhood shopping center. This area is somewhat removed from the BART station being located further north on "G" Street adjoining the shortly to be developed central waterfront. Much of Pittsburg's 200 acres of retail/commercial space is located within this 16 block area, and if redevelopment can be achieved, the district could accommodate most of Pittsburg's future retail needs. With a 1990 population of 47,930 persons, a ratio of 4 acres of retail-commercial uses per thousand persons would exist which compares favorably with the normal 3 to 4 acres per thousand persons. Thus, there would be little likelihood of extensive retail-commercial development within close proximity to the BART station.

A planned office complex, on the other hand, would be a more viable use for the area immediately north of the BART station. Pittsburg presently has a limited tax base which limits Pittsburg's efforts to finance needed city services and improvements. This is because the principal industrial tax base was outside city limits, although these tax sources are included in the tax district of the Pittsburg Schools and Community Hospital. The city should therefore benefit by actively encouraging office/commercial development and other related uses which BART could create a market for. Although, as such, official commercial redevelopment will create many new jobs, it is doubtful whether the presently poor population; $7,600 per household, compared to the County average of $9,000 will directly benefit from these improved job opportunities. Because, with BART, more people will be able to come to Pittsburg to compete for those jobs resulting in many unskilled workers being forced to seek jobs elsewhere which conversely could be made more accessible by BART.



Parks and Recreation Facilities: As part of the BART improvements, a parkway would extend for almost the entire length of 8th Street under the BART aerial structure. As such, this parkway could form the backbone of a pedestrian and bicycle pathway system for persons bound for the BART station or other locations within the community. Also, new developments such as a station-related office park or higher density housing which might eventually replace single family detached housing west of Railroad Avenue on either side of 8th Street, could be designed to provide an extensive landscaped pedestrian environment.

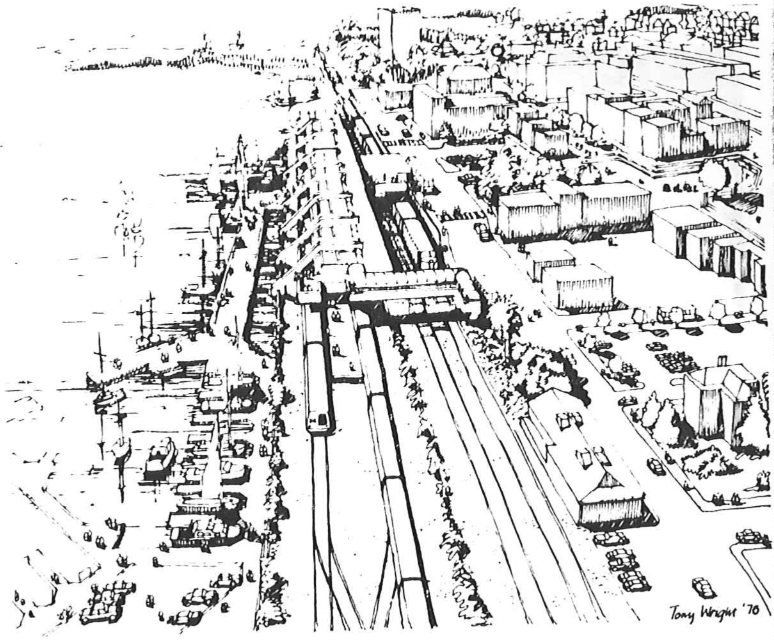
Alternative Alignment

During the first phase of the project study when the seven alternative extensions were being developed, a variation of the BART alignment for Alternate I was investigated for that portion running through Pittsburg. It held the same horizontal alignment as the recommended aerial structure in the median of 8th Street, and the Pittsburg Station was still located just east of Railroad Avenue, but the line and station construction type had a subway configuration. The reason for studying this alternative was that a subway solution under 8th Street would reduce the noise and visual impacts of BART along that corridor. Existing 8th Street is presently a two-lane street with a large median down which the Sacramento Northern ran an occasional freight train until just a year or so ago. The area on both sides of the street consists mainly of older residences.

Because of the desire for the BART tracks to be in subway by the time they reach Beacon Street at the western edge of developed Pittsburg, it became necessary for the line to pass beneath the relocated Sacramento Northern spur before BART entered the abandoned SNRR property. From the vicinity of Beacon Street the line continued in subway with an underground station between Cumberland and East Streets. Since the whole purpose of the line would be to eliminate the sound and sight of BART in Central Pittsburg, the line had to remain in subway until it passed beneath Harbor. Though a line passing over this street and the adjacent railroad tracks would violate the basic reason for the scheme, this solution was analyzed and found to be possible only if East Street and probably even Los Medanos Street were closed. Therefore, the line remained in subway beneath Harbor and the railroads, whence it ascended to pass over the Atchison, Topeka and Santa Fe yard on a double-column bent-supported aerial structure.

The additional construction cost of the subway line over the proposed aerial line was estimated to be 18 million dollars. Since this section through Pittsburg is similar to the alignment in Port Chicago Highway in terms of exposure to residential property, the additional cost could be reduced somewhat depending upon the cost of reducing the noise impact of the aerial line on the adjacent neighborhoods.

Antioch Station



The Antioch Station is located between "G" and "I" Streets and on the northerly side of the Santa Fe Railroad tracks, mainly on filled land along the San Joaquin River. The station will serve the City of Antioch, Brentwood and other parts of East Contra Costa County.

The objective of this waterfront location is twofold: firstly, to stimulate marina and associated waterfront development, and secondly, to provide a bridge between these activities and a revitalized retail core area and the proposed new Civic Center at "E" and 2nd Streets. The actual location and layout of the parking areas have been established to encourage as many people as possible to arrive at the station by bus and kiss-ride modes, thus lessening the dependency on the automobile for BART related trips, and reducing the need to locate a large reservoir of parking immediately adjacent to the station. With this in mind, the BART station is considered here as a focus of activities rather than an isolated facility within the community. Details of the BART parking areas are shown in Figure 5-19.

Kiss-Ride Facilities

Two kiss-ride areas and a bus stop would be provided along the sides of 1st Street between "G" and "I" Streets. These areas would accommodate a total of 30 kiss-ride stalls and 4 to 8 bus pull-offs. The majority of passengers unloading from buses and kiss-and-ride locations could walk directly into the BART station "free zone" area at the same level. Additional kiss-ride areas would be available between "I" and "H" Streets and in a designated portion of the BART park-and-ride lot off "I" Street between 1st and 2nd Streets. BART patrons could have access to the station from these areas via a stairway and bridge spanning the railroad tracks at the foot of "I" Street.

Park-and-Ride Lot

A four hundred-car parking lot could be provided on a largely vacant parcel of property between "I" and "L" Streets between 1st and 2nd Streets. The old railroad hotel, now a private house, could be saved and purchased under a joint agreement by the City of Antioch and BART, and renovated for hotel or office use. BART parking in this location could serve the dual purpose of being used on weekends for marina and downtown shopping purposes.

An alternative parking lot location was examined between "G" and "E" Streets between 2nd and 3rd Streets adjacent to the proposed new Civic Center complex. The possibility of concentrating parking and automobile oriented uses in this general location could be an important consideration in the future in view of good access from "G" Street and necessary street improvements associated with proposed Civic Center developments. However, property acquisition costs could be considerable. Also, a location here could cause increased congestion to nearby businesses on "G" Street and beyond.

Pedestrian Access

Extensive landscaping adjacent to the old AT&SF Railroad Station affords an attractive pedestrian link between the BART station and proposed parking lot. This could be expanded as part of BART improvements to include complete landscaping, lighting, and signing along First Street. Also, the partly landscaped strip of property directly west of the proposed kiss-ride lot would provide the major link between the BART station and redevelopments which could occur between 1st and 3rd and "G" and "I" Streets.

A mini-park could be created at the foot of "G" Street to the east and connected via a landscaped trail to the city's birthplace at the foot of "F" Street through to "E" Street and the proposed Civic Center complex.

Public access to fishing piers and the marina could be enhanced by providing a continuous boardwalk along the waterfront, linking these activities and the Civic Center to the BART station "free zone" area.

Automobile Access - Circulation Plan

Principal access to the BART station would be on "A" and "L" Streets. "A" Street presently serves as the main feeder arterial for both east and westbound traffic.

Present average daily volumes on "A" Street are in the region of 15,000 vehicle trips with traffic diverting onto various east-west streets including 10th and 6th into downtown Antioch before it reaches 4th Street.

"L" Street, on the other hand, has a low average daily traffic volume in the region of 4,500 vehicle trips and is presently only accessible from State Route 4 via an eastbound ramp.

It is anticipated that the SR-4 "L" Street intersection will eventually be reconstructed to a diamond configuration providing

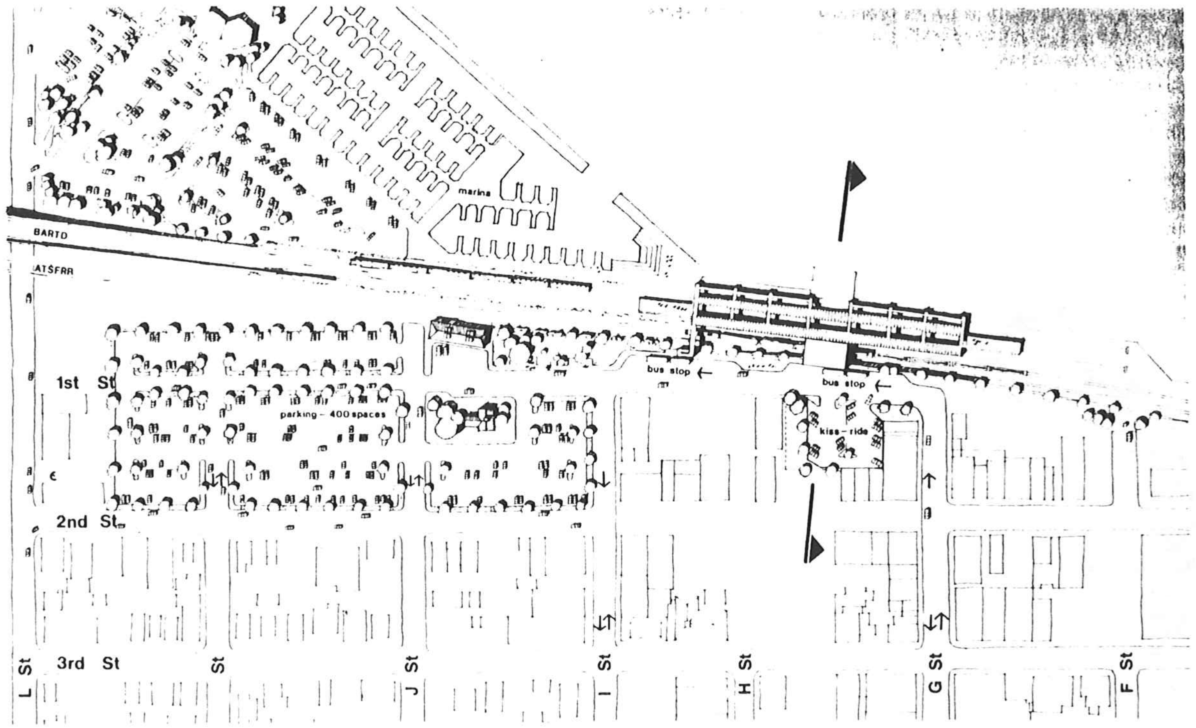
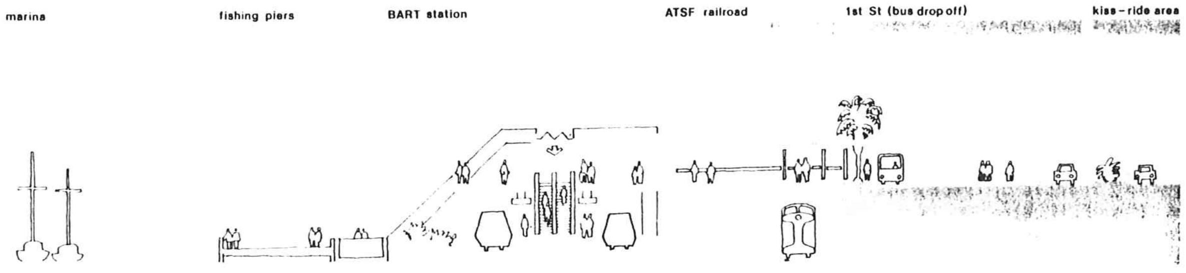


Figure 5-19. Antioch Station and Parking Lot Layout

Figure 5-20. Typical Station Cross Section



Chicago Highway interchange wit

more direct access to BART park-and-ride areas for BART patrons coming from the south and east parts of the County. The result of turning "L" Street into a major north-south arterial providing access to downtown Antioch will shift traffic from "G" Street and others onto "L" Street. It is also anticipated that public transportation service would be routed onto "G" Street as the most direct access route to the BART station and a redeveloped downtown Antioch. A circulation plan illustrating access to and from the station is shown in Figure 5-21.

Bus Feeder Service

Antioch presently has no bus service other than Greyhound. Recent local attempts to operate a mini-bus service resulted in closure by the PUC. However, one solution to providing this service if no local bus system exists at the time BART is extended is that the BART Express Bus lines, which will be local in nature in Antioch, could be re-routed to serve the BART station.

Also, local feeder transit could provide in-community public transportation to shopping, water-front recreation activities, industrial job locations, as well as enable people to travel to essential public services in the proposed new Civic Center complex.

Station Area Characteristics

The BART station would be located at the riverside of the Atchison Topeka and Santa Fe Railroad tracks. These tracks have traditionally formed a barrier to development along Antioch's waterfront, the only improvement being the restaurant with adjacent parking reached by track crossings of "I" and "H" Streets. A few commercial establishments remain on First Avenue but principal existing retail activities concentrated along "G" Street, stores selling apparel , general merchandise, and home furnishing and convenience goods, catering almost exclusively to a local market area. The existing City Hall and adjacent parking are located in the center of the retail/commercial area about two blocks from where the BART station would be situated.

Although the blocks south, east and west of the commercial area are zoned for higher density housing, older, smaller single family housing predominates. Deterioration is noticeable in some structures, especially westerly blocks, but the general impression is one of an area of well kept and cared for homes.

There have been no recent developments in the vicinity of the station although the City of Antioch is planning a new City Office complex between "E" and "G" Streets and between 3rd and 2nd Streets; a distance of some 1000 feet from the station entrance.

STATION AREA DEVELOPMENT POTENTIALS

It is clear from an overview of the types and conditions of existing uses in downtown Antioch that BART could have a major social, economic and physical impact. If and when the Pittsburg-Antioch BART extension is committed, a set of definitive guidelines and recommendations should be made in the context of a comprehensive plan for downtown Antioch so that the City can begin structuring developments in the best interests of the community well in advance of BART. In the interim, and as

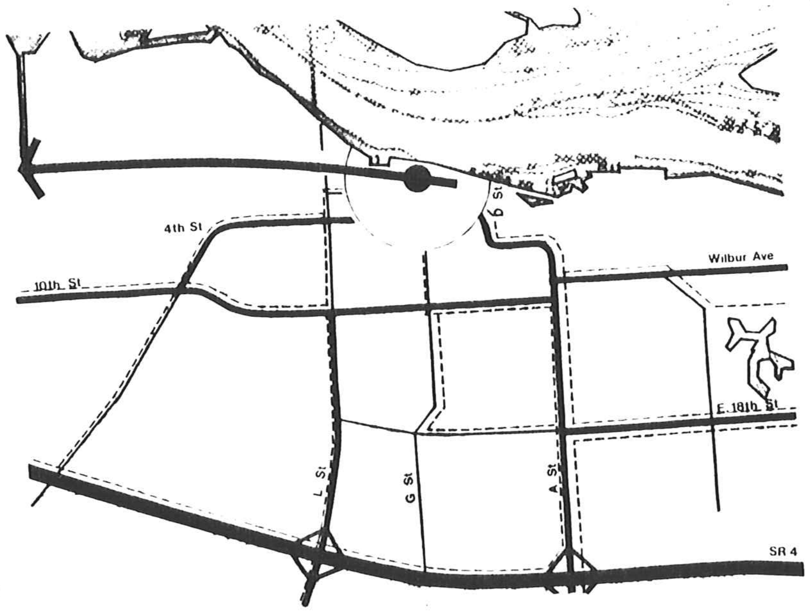


Figure 5-21. Antioch Station Circulation Plan

- ▬ Freeway
- ━ Major Arterial Street
- — Collector Street
- ● BART Station
- ⟷ BART Route
- - - - Feeder Bus
- ○ 1/4 mile Walking Distance

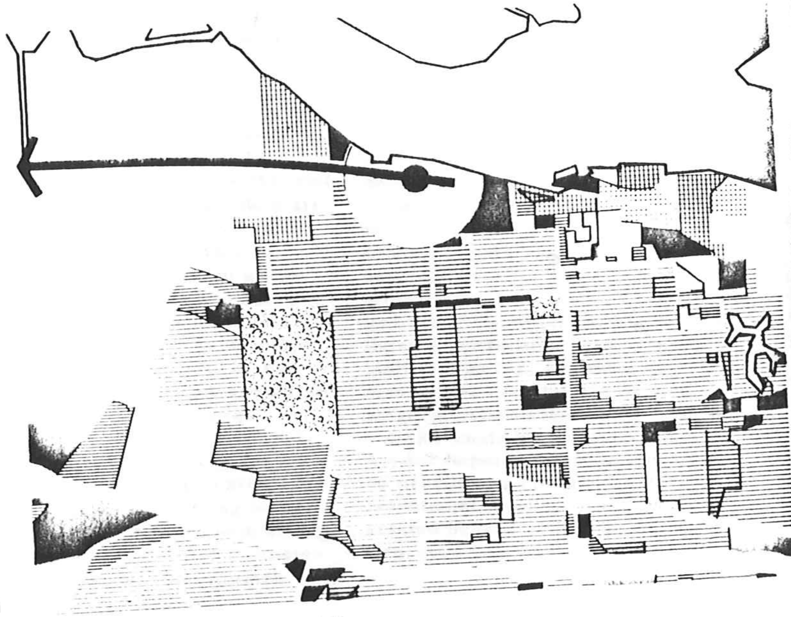


Figure 5-22. Antioch Land Use Plan

Existing

- ▤ Activity Center
- ▒ Multi-family Residential
- ░ Single family Residential
- ▥ Industrial
- ▩ Parks and Open Space

Planned

- ■ Activity Center
- ░ Multi-family Residential
- ░ Single family Residential
- ▦ Industrial
- ▩ Parks and Open Space

part of the planning process adopted for this study, the following set of possible physical developments are presented.

Station area redevelopments are based on an interprolation of 1990 economic projections made during the study, review of local plans and proposals, and familiarity with redevelopment impacts at existing BART stations. Previous efforts to generate interest have provided some indication that central business district owners would take a financially conservative approach to involvement in such efforts. However, there is substantial community interest in revitalizing the downtown and waterfront areas.

With the possibility of a waterfront end of line BART station, the picture could be expected to change considerably

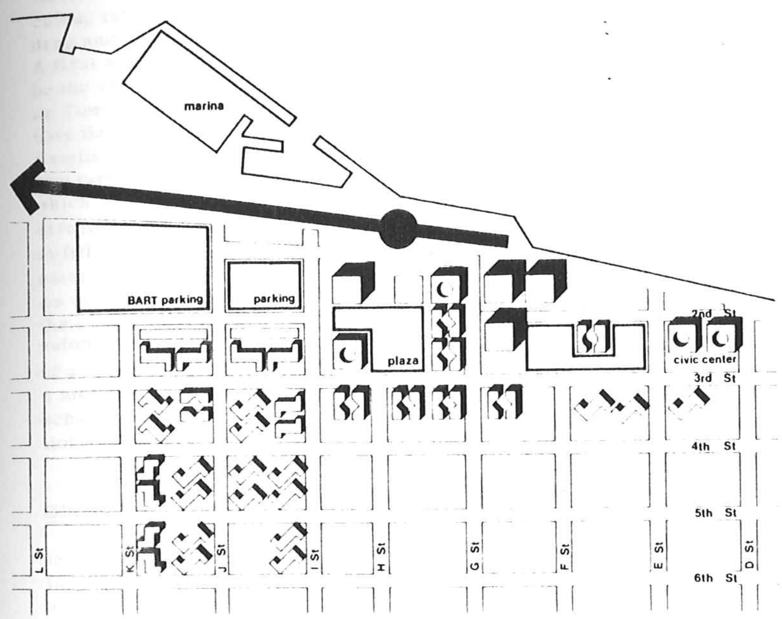


Figure 5-23. Antioch Station Area Development Concept

Office commercial

Retail commercial

Neighborhood commercial

High density housing + 25 d.u./acre

Medium density housing 5-25 d.u./acre

Community facility

Civic/cultural facility

● BART station

⟷ BART route

d.u./acre = Dwelling units per acre

Waterfront-Recreation Facilities

The City of Antioch has a rapidly expanding population and a downtown with a need for additional improved public access to and from activities on the waterfront. A marina and related restaurant facilities would not only add a valuable recreational resource to the city and region, but would create an exciting new potential for the existing central business district.

One objective would be to provide a broad range of recreation and activities through provision of commercial facilities, such as a marina basin, with adequate parking, boating (possible boat sales), trailer parking, a yacht club, and direct public access to the waterfront through a network of pedestrian pathways and public spaces.

Park and Open Space Facilities

The Parks and Recreation element of Antioch's General Plan indicates a substantial amount of the City's waterfront will be converted to open space and water-oriented recreation facilities. As part of the overall marina development, passive and active (play) parks could be planned, together with a series of trails and pathways including a boardwalk along the waterfront.

A boardwalk could provide a continuous pathway system linking the marina complex aad fishing piers to the BART station, the City Park complex and as far east as the proposed 84 acre Sand Dunes park. The proposed marina should occur in the context of a downtown redevelopment plan which could be phased to include park and residential development.

The main access road into the marina project could be provided by an extension of "L" Street under the BART aerial structure. Improvement of "L" Street is envisioned as a principal access route to BART parking lots. The waterfront area could possibly support two restaurants and perhaps a small indoor/outdoor coffee shop. Although the popularity of the existing restaurant provides some indication of this latent demand, demand would be stimulated by an overall increase in income levels, the attractiveness of a redeveloped downtown area, and the kind of clientele who will patronize this end-of-the-line BART station. Both air rights over the BART station and in the marina itself provide exceptional locations with views out across the San Joaquin and Sacramento Rivers to the Montezuma Hills. A seed project to development of the marina would be the relocation of the existing restaurant cluding parking and access.

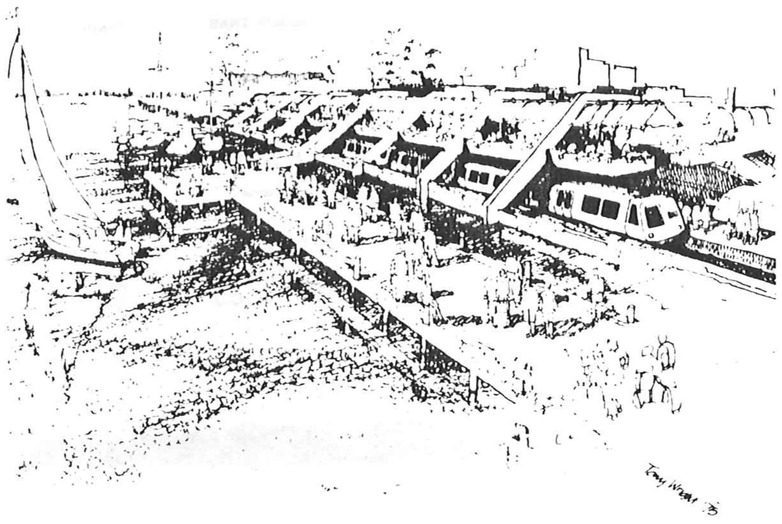
Commercial Development

Revitalization of the central business district providing for a specialty shopping area with strong pedestrian orientation is a consistent feature in both the Antioch General Plan and the Antioch Planning Staff recommendations as well as being a strong community expression. (5)

Many stores are marginal operations and numerous store fronts remain vacant. This condition is borne out by an examination of recent sales, which indicates a gradual decline in business; a fact which is in part due to competition from the recently completed County East Shopping Center.

There have been recent attempts to revamp "G" Street with sidewalk awnings, building graphics, planters and echelon street parking. These attempts have been largely cosmetic and without a major "seed" project there appears little economic justification for, or potential demand for revitalized or new retail activity in downtown Antioch.

BART could help provide the needed impetus for redevelopment by providing a climate for direct investment incentives and inter-related benefits resulting from improved regional accessibility,



Based on 1990 retail sales projections conducted as part of this study which indicated a warranted demand sufficient to support 2 or 3 small local retail centers in the corridor, redevelopment of a key portion of downtown Antioch appears quite feasible. The intention here would not be to compete with certain kinds of service offered in Antioch's County East Shopping Center, but rather to help revitalize and provide a new image for downtown Antioch by developing a small, compact convenience shopping area. Businesses aimed at satisfying local and BART rider needs could include boutiques, florists, specialty restaurants, cafes, taverns, small appliance, drug and food stores.

A first step or "seed project" could be the creation of a shopping plaza or Town Square where present City Hall parking is located. Existing buildings could be restructured to house businesses which face onto the square. New structures might also be built to fill in the numerous gaps which exist and provide retail continuity. As such, the square could act as the necessary incentive for redevelopment and pedestrianization. of a 4 to 6 block area and provide a meeting and display center for school activities, local organizations, clubs and associations.

Office Development

Overall increases in population in the Antioch area will result in increased employment in real estate, insurance, building trade, legal service and other professions. In addition, the availability of potentially highly attractive end of the line locations could well create a demand for a 6 to 9 story office building within close walking distance of the BART station.

Possible locations for new office space include the area west of the proposed Civic Center complex, bounded by 3rd and "G" Streets and the railroad.

Location of the administrative headquarters of the Antioch Unified School District might be considered together with a private office building for this general area. Office locations here would result in a planned concentration of private governmental and institutional office uses, all within 1000 feet of the BART station.

Residential Development

Market research indicates a practical demand for 2,857 new residential units in Antioch, north of SR-4 through the 1974-1990 period. It is estimated that approximately 70 percent of this demand will be multi-family housing. Although Antioch has traditionally been a single family home owner community, multi-family units are projected to increase in number and density. The Antioch General Plan(5) estimates an increase from 9.3 units per acre in 1970 to approximately 17.0 units per acre in the year 2000.

No attempt has been made here to estimate what proportion of this demand would be "commuter" oriented It is assumed that locations within close walking distances of the BART station could become highly attractive to individuals and families who want to be close to shopping, schools, recreation and access to work without being totally dependent on the automobile for access to any of these activities.

Zoning

Properties in downtown Antioch could become highly attractive to investors, interested in residential and commercial redevelopment. Emergence of a medium to high density environment in downtown Antioch would represent a dramatic change in the prevailing low-key, low density character. This situation is probably necessary and desirable in order to capitalize on the high transportation capability of BART and the potential rejuvenating investment interest resulting from it. However, use and density changes should be staged in order to avoid undue social and economic disruption. Also, it would give the City time to research, apply, and test methods of tax increment financing which could be used to fund necessary capital improvements such as parks, plazas, bicycle trails, street planting and other environmental amenities which would enhance and improve downtown liveability and ties with BART.

The following suggestions are made concerning zoning changes which might be made only in the long term when demand and amenities are sufficient.

- Existing downtown commercial zoning (C-2) could be reduced to 5th and "F" Streets and mid-block between "H" and "I" Streets to encourage compact redevelopment rather than open-type establishments
- Manufacturing (M-1) could be changed to a special office/commercial zone between "E" and "B" Streets north of 3rd Street to permit anticipated office development in that area.
- Increases in residential density, especially for family use should be permitted in areas with good pedestrian access to the station (less than 2000 feet away). However, single family housing should be preserved until the housing market strengthens for this scale of construction.

Alternative Station Locations

Some interest has been voiced in Antioch for a BART alignment on 4th Street with a station located at "G" Street. According to a Lampman and Associates report,(6) BART would run on aerial structure in the median of 4th Street with the station structure extending on either side of "G" Street.

Since the City is considering widening 4th Street to 4 lanes and since the existing street R/W is only 60 feet wide, it will be necessary to take a strip of developed land on one side or the other of 4th Street to provide the additional space needed for the BART line.

The horizontal space needed for BART is quite wide (see Figure 5-25) since the terminal station must be a center platform type to allow a double crossover to be placed between the right and left tracks. This is required so that a second train can pull into the terminal station while one is still there or just leaving. This operation conflict would occur during

Figure 5-24. Alternative Alignment Antioch - Section thru Cross-over Tracks

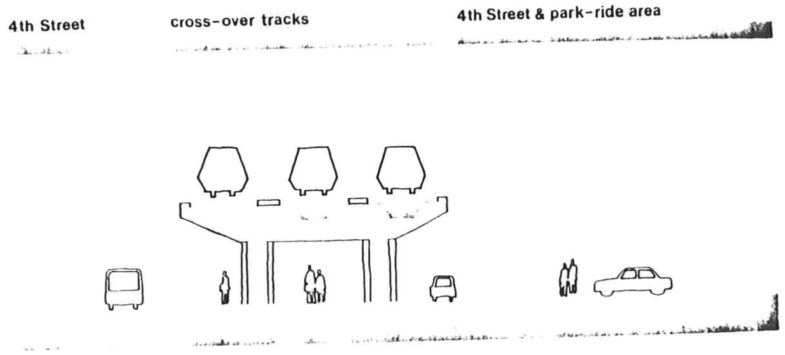
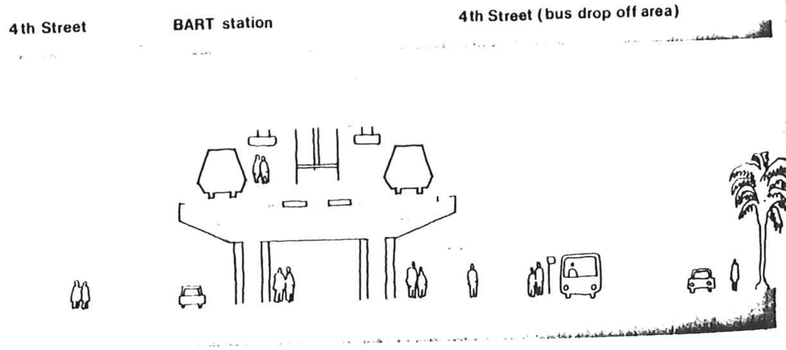


Figure 5-25. Alternative Alignment Antioch - Section thru Station



the peak hours when the headways are down to 6 minutes. From a preliminary examination it it appears that the 40 foot plus strip of land should be taken along the north side of 4th Street, though some geometrical problems would occur at the west side of town if an attempt is made to miss one of the newer Fibreboard buildings.

A widened 4th Street would extend from the Fibreboard facility to two hundred feet east of "F" Street. The extra 200 feet beyond the end of the station is a safety factor against train overruns. The actual BART aerial structure would be a massive deck, supported on two column bents, from the west to "O" Street (due to the end of the yard tracks at this point), then it would transition to two single column bents, each supporting a track, and finally to the large double-column bent structure again for the double crossover in the last 800 feet before the station. Due to the fact that all trains leaving the yard will go into the Antioch Station first, and that there will be continual use of the crossover tracks, this section of the BART line should generate more noise than the average portions of BART track within the system.

Widening of the street would aggravate cross-street movements somewhat and the median for BART would create a substantial visual barrier.

A little less than 5 acres are needed for BART parking, bus and kiss-ride areas. This is equivalent to about four of the typical square blocks in the area which appears to consist mainly of commercial and business-professional buildings.

As far as the accessibility of the station and parking lot, the location on 4th Street would be positive. However, coupled with the City's desire to make "L" and "A" Streets the major north-south arterials, while down-grading "G" Street, the "G" Street site would work against this.

There is no physical or geometric restraint in bringing the BART line into this location. However, the yard would be pulled away from the Atchison, Topeka and Santa Fe Railroad tracks and be placed diagonally across the field between these tracks and the Pittsburg-Antioch Highway. This could have two detrimental affects. First, it would create a physical barrier to future development of the parcel as a whole. Secondly, it would greatly increase the adverse environmental impact on the large pond in that area since it would cut it in half. On the east side of the Antioch Station, there would be substantial community impacts if the line was ever extended. However, the chances of this occurence are low: A Cal Trans sponsored study recommended that any mass transit connection to a high speed rail system serving Sacramento take place in Richmond.

Another alignment through Antioch has been suggested but it would place the station in almost the same location. This alternative would keep the BART line and station on the south side of the AT&SF tracks with the same configuration as the recommended line between the yard and the Antioch Station. This scheme should be investigated in more detail when the next design stage commences. Consideration must be given to impacts on the CBD and marina development, access to the cannery, and costs.

Section 6: Patronage and Operations Plan

An important input to the PAX study effort was the estimate of incremental patronage attributable to an extension of rail rapid transit from Concord into the Pittsburg-Antioch corridor. This patronage estimate is necessary to provide the design basis for facility requirements, including: station parking lots and related street improvements, fare collection equipment an operations plan upon which, rolling stock requirements can be based; yard needs; and an estimate of incremental gross revenue and operating costs.

The patronage projections used were developed in Task III of the MTC sponsored Regional Transit Travel Projections Project (RTTPP). This section will discuss the RTTPP, the estimated patronage associated with modified Alternative 1, and the operations plan necessary to satisfy the estimated extension patronage.

THE REGIONAL TRANSIT TRAVEL PROJECTIONS PROJECT (RTTPP)

The RTTPP was organized in 1972 for the purpose of providing coordinated patronage projections for the Bay Area transit planning effort. Resources from five planning projects were allocated to the RTTPP in addition to MTC resources and technical support. The planning projects involved were:

- Pittsburg-Antioch BART Extension Project
- Livermore-Pleasanton Extension Project
- Northwest San Francisco Rapid Transit Project
- San Mateo County Transit Development Project
- Golden Gate Bridge District Corridor Project

The RTTPP produced patronage projections in progressive stages of refinement. Task I provided order of magnitude estimates of daily work trips only. This information was furnished to all corridor study teams. Task III output was designed to reflect total transit patronage projections associated with several alternative regional transit and highway network assumptions in combination with different levels of regional growth.

RTTPP Task III Model and Inputs

A transportation model is essentially a series of mathematical relationships which stimulate travel behavior. Because of the many calculations involved, the processes are computerized for timely, economical use. This results in the physical form of the model being a set of computer programs expressing travel relationships which are based on observed Bay Area travel behavior.

The model developed by RTTPP is more disaggregate than previous Bay Area regional transportation models in that it operates on not just one measure of zonal residential or economic activity, but several. Information on households for each zone is input in terms of six income groups and two structure types. Zonal economic activity is represented by the number of workers in each of six employment categories. Thus the model is theoretically more sensitive to habits among people in a given zone, community or corridor.

The RTTPP model simulates travel patterns by taking into account systematically the "disutility" of each potential trip. The disutility involved in each part of a trip is reflected by transit and highway networks which both contain measures of the time and cost of travel by all modes. Travel from each place to all others is influenced both by the relative magnitude of activity at each potential destination and by the degree of ease or difficulty (cost and time) involved in traveling to each destination. The distribution of travelers between any two points among potential modes of travel is determined by the relative attractiveness of each mode.

Since 1990 was selected as the primary forecast year, all network and growth inputs were designed to reflect assumed 1990 conditions of interest to each study. In order to maintain a coordinated set of regional growth data while at the same time being responsive to specific regional growth assumptions, the MTC-ABAG Series 2 GROSOUTH regional growth forecast were utilized. Zonal variations of the GROSOUTH forecasts were input by each corridor study team to reflect specific growth assumptions for each Task III test. When all inputs were reviewed by RTTPP staff, an adjustment process was utilized to maintain the forecast relationship regionally between households and employment. The adjustment took the new employment level as a given and adjusted the input household data.

In summary form, the input data for the PAX corridor utilized in RTTPP Task III, Test 3 (PAX Alternative 1) were as follows:

Total households	(1990)	120,140
Total Employment	(1990)	103,800

Given the travel relationships manifest by different income-structure type households and various employment groups, the disutility of travel by each mode between all possible origins and destinations, and estimates of the number of households and employed persons in each zone, the model projects future levels of travel on the highway and transit systems.

PATRONAGE

Approximately 118,000 daily person trips by all modes are forecast across the "screenline" between the corridor and that portion of the region which is south and west of the corridor. The distribution by mode of these trips is as follows:

Highway	81,500	69.0%
Rapid Transit	33,600	28.5%
Local Transit	2,900	2.5%
Total	118,000	100.0%

Of the roughly one-third of the total person trips which are projected to be made by transit, more than 90% are estimated to travel via rapid transit and the remainder by local bus service.

Rapid transit patron volumes by station are indicated in Table 6-1.

The forecast of 36,200 daily rapid transit trips amounts to an estimated 10,679,000 trips annually. The annual figure is based on 295 equivalent work days, which takes account of the fact that transit riding currently is greater on work days than weekends.

OPERATIONS PLAN

Operational Considerations for PAX

The expansion of BART service, particularly by way of a direct rail extension as this study proposes, must be considered within the operational context of the entire BART system - not as a separate operating entity.

Reliable service coordination throughout the system is insured through the use of Automatic Train Control (ATC). ATC makes it possible to maintain consistent

Table 6-1. 1990 Average Daily Rapid Transit Trips by Station (1)

Station	Work	Non-Work	Total	Attractions Work	Attractions Non-Work	Attractions Total	Total Station Trips
Antioch	7,800	3,300	11,100	1,000	500	1,500	12,600
Pittsburg	6,300	4,400	10,700	1,000	800	1,800	12,500
West Pittsburg	2,900	2,100	5,000	200	300	500	5,500
North Concord	3,000	1,700	4,700	400	500	900	5,600
Concord	15,200	10,300	25.500	800	2,500	3,300	28,800
Total PAX (2)	20,000	11,500	31,500	2,600	2,100	4,700	36,200

(1) Based on RTTPP Task III, Test 3 output, includes intra-corridor trips.
(2) Excluding Concord Station.

scheduling and dependable service on a systemwide basis - positive factors for both the operators and patrons of the rapid transit system.

Where an interface occurs with other scheduled transportation modes such as bus feeder systems at BART stations, it is also desirable to establish schedules which allow smooth service coordination and reinforce the high level of service for the rider and the operating efficiency of the total transportation network.

Oftentimes, however, operating constraints of the transit system and/or travel patterns of transit patrons make it difficult to provide maximum levels of service. When this happens it becomes necessary to make adjustments and tradeoffs between these two factors in order to provide the best service possible within BART's operational parameters. Planning for the operation of BART service into the Pittsburg-Antioch corridor is no exception.

This section will discuss the problems and opportunities involved in providing the benefits of the regional rapid transit system to residents of the PAX corridor.

Equipment and Facility Requirements

Using 1990 Patronage Forecasts for PAX, and assumptions made by BART for its maximum achievable levels of service during full system operations, the equipment and support facility requirements for operating the PAX extension were determined.

The analysis of storage and maintenance facilities needed to support this extension resulted in the determination that a new yard would have to be constructed in addition to the existing one located at Concord. A more detailed description of this analysis is presented in Section 7. This new yard and the existing yard represent a critical factor in the establishment of the most efficient operating scheme for blending service provided on the extension into BART's total operations plan. The existence of the two yards, both located between the Daly City and Antioch Stations, did make it difficult to reach a maximum level of operating efficiency and to provide an optimum level of service for the BART rider.

BART's Existing Operations Plan

Service on the existing 75-mile system depends on an operations plan integrating 4 separate lines: Concord-Daly City, Fremont-Daly City, Richmond-Daly City, and Richmond-Fremont.

Direct service will soon be provided from the three East Bay terminal stations in Richmond, Concord, and Fremont to the sole West Bay terminal station in Daly City. The primary destination of these three direct service lines are the downtown stations of San Francisco. The fourth direct service line on the system connects the Richmond and Fremont terminals via downtown Oakland. To reach downtown Oakland from the Concord-Daly City line stations requires a transfer at the MacArthur Station.

Although this operations plan may be changed between now and when service is provided on PAX, this operations analysis will assume that Daly City will remain the only direct line connection from the Concord Stations.

PAX - As a Part of the BART Operations Plan

Planning for the extension of BART service into the Pittsburg-Antioch corridor has been based on the assumption that the extension would be integrated into BART's full system operations plan. Implicit in this assumption is non-transfer service between Antioch and Daly City. Shuttle service between Antioch and the Concord Station requiring a transfer to continue the trip to Daly City was not considered to be operationally acceptable. In addition to the preceding decisions, the following assumptions were made as a basis for formulating the operations plan:

1. Minimum peak headways in and out of San Francisco will be two minutes.
2. Southern leads will be provided at Concord Yard.
3. A double-ended pocket track will be provided approximately 1600 feet north of the Concord Station. This track will be mainly used to turn back trains at Concord.
4. Twelve minute peak period service from areas north of Concord Station, in other words, along the entire extension, will adequately serve anticipated patronage.
5. The Antioch Yard will be built west of Antioch and will be located between the main line tracks.
6. Both Concord and Antioch Yards would be equipped to perform all regular services and maintenance requirements.
7. A crossover facility, specifically another double-ended pocket track, will be constructed approximately midway between the West Pittsburg and the Pittsburg Stations.

Several alternative operating schemes were considered which reflect differing balances between levels of service and operational efficiency for the extension and the total BART system. BART's operations staff determined that the following service schedule best satisfies service and operational requirements of the proposed Antioch extension within this total system operations context.

SERVICE SCHEDULE

AM Peak Service (Monday-Friday)

Trains will be dispatched from Concord and Antioch Yards to Concord and Antioch Stations respectively. The first train will depart from Concord Station toward Daly City. The second train will leave Antioch Station and will arrive at Concord six minutes following the first train's departure. This pattern will continue until ten trains have been dispatched from the Concord Yard. At this time the earlier trains dispatched from the Concord Yard will begin arriving and being turned back at the Concord Station.

Trains will continue to be dispatched from Antioch until a total of about 14 of these trains are on the line. At this time the earlier trains dispatched from Antioch Yard will begin arriving and reversing direction at Antioch Station. All trains dispatched from Concord Yard will turn back at Concord Station and all trains dispatched from Antioch Yard will reverse direction at Antioch Station.

The above pattern will result in the following peak period headways:

(1) Concord to Daly City at 6 minute headways.
(2) Antioch to Daly City at 12 minute headways. (Antioch, Pittsburg, W. Pittsburg, North Concord)

Base Period Service (Monday-Friday)

At the end of the AM peak all trains originally dispatched from the Concord Yard will be taken out of service at that facility. This would result in fourteen trains providing 12 minute service to the entire Contra Costa Line. Selected Antioch trains will be exchanged for shorter consists at that location.

PM Peak Service (Monday-Friday)
Ten trains will be dispatched from the Concord Yard at twelve minute intervals to alternate with the trains from Antioch. This will provide service identical to the AM peak.

Saturday Service
Twelve trains will be dispatched from Antioch to maintain 15 minute service.

Sunday & Holiday Service
Twelve trains will operate out of Antioch Yard to provide 15 minute "X - Service".

Evening Service (Monday-Friday)
Same as base period service.

Late Evening Service (Monday-Friday)
Nine trains will operate out of the Antioch Yard on 20 minute headways to provide Antioch-Daly City "X - Service". This is the system operation under which service is provided on two basic routes: Antioch to Daly City and Fremont to Richmond.

BART is considering other extension possibilities such as Livermore or the Oakland Airport. In addition, actual patronage on the BART system may vary from the initial forecasts. For these reasons any operations plan for PAX should be considered only as an illustration of how the extension could operate. Alternative operating plans may vary the operating costs and yard requirements.

IMPACT OF PAX EXTENSION ON BART (CONCORD - DALY CITY LINE) SERVICE

At present trains on the Concord -Daly City "C" Line are crowded during the A.M. and P.M. commute periods. Improved train frequency (to 6 minutes headways, as proposed) and maximum 10 car trains will increase capacity and reduce this overcrowded condition:

An extension of BART services to Pittsburg-Antioch would both foster and serve growth in that corridor, placing increased demands on BART commute service. Additional commuters from the Pittsburg-Antioch area could cause trains to be full (one standee for every seated patron) on arrival at stations down the line. Thus a number of commuters who would otherwise be boarding trains at Walnut Creek, Lafayette and Orinda may choose other forms of transportation to get to work. BART planning, to date, has assumed that when load factors of 2 are reached (same number of people standing as seated) additional patrons would be discouraged from using this system.

The following analysis will assess the impact of an extension of BART Services to Antioch or ridership from other stations on the Concord line in 1990. These future service levels will also be compared with anticipated levels for the Non-Extension option.

Patronage forecasts used are derived from the Regional Transit Travel Projections Project. (RTTPP) Tests 1A, 3A and 5.

Test 1A, which assumes no extension of BART beyond Concord, provides an estimate of 1990 "C" Line patronage levels and a baseline for measuring the impact of an extension.

Tests 3A and 5 each assume an extension through the downtowns of Pittsburg and Antioch, as proposed in this study. The principle differ-

Table 6-2. Station to Station Links - Estimated Daily Two Directional Link Volumes

	Test 1A			Test 5		
Station to Station Links	Work	Work	Total Daily	Work	Non Work	Total Daily
Antioch to Pittsburg	No Extension			8,110	3,407	11,517
Pittsburg to W. Pittsburg				14,274	7,801	22,075
W. Pittsburg to N. Concord				16,548	11,651	28,199
N. Concord to Concord				16,524	11,631	28,155
Concord to Pleasant Hill	26,172	10,363	36,535	33,955	21,736	55,691
Pleasant Hill to Walnut Creek	31,964	11,472	43,436	40,689	22,974	63,663
Walnut Creek to Lafayette	43,300	14,942	58,242	54,911	26,752	81,663
Lafayette to Orinda	49,531	16,658	66,189	62,773	29,004	91,777
Orinda to Rockridge	51,811	17,506	69,317	65,445	30,045	95,490
Rockridge to MacArthur	53,840	17,906	71,746	67,383	30,523	97,906

Source: BART Offices of Planning and Research, 1975

Table 6-3 Concord-Daly City Line Capacity - 1990 - With and Without PAX

			Peak = 85% Work		Peak = 85% Work	
Station to Station Links	Headway	2 hour one-way Seating Capacity	L.V.	Avg. L.F.	L.V.	Avg. L.F.
Antioch to Pittsburg	12 min.	7,200	-	-	3,447	0.48
Pittsburg to W. Pittsburg	"	7,200	No Extension		6,067	0.84
W. Pittsburg to N. Concord	"	7,200	-	-	7,033	0.98
N. Concord to Concord	"	7,200	-	-	7,023	0.98
Concord to Pleasant Hill	6 X 4 min.	14,400	11,123	0.77	14,431	1.00
Pleasant Hill to Walnut Creek	"	14,400	13,585	0.94	17,293	1.20
Walnut Creek to Lafayette	"	14,400	18,403	1.28	23,337	1.62
Lafayette to Orinda	"	14,400	21,051	1.46	26,678	1.85
Orinda to Rockridge	"	14,400	22,020	1.53	27,815	1.93
Rockridge to MacArthur	"	14,400	22,882	1.59	28,637	1.99

1. L.V. - 2 hr. peak period Link Volume - Boarded Passengers Between Stations
2. L.F. = Train Load Factor, shown as an average
3. Assumes a 2 hour peak period, and peak directional flows.

Source: BART Offices of Planning and Research, 1975

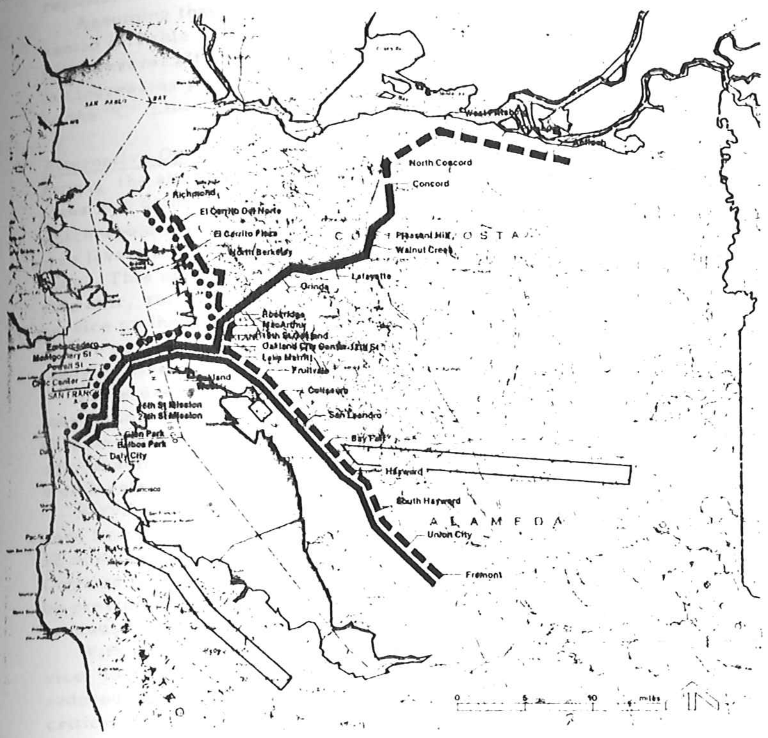


Figure 6-1. BART Route Plan

▬ Concord/Daly City	▬ ▬ ▬ Richmond/Fremont
▬ ▬ ▬ PAX Extension	▬ Fremont/Daly City
●●●●●● Richmond/Daly City	☐ Extensions Under Study

Table 6-4 - Concord-Daly City Line Capacity - 1990 - With Alternative Operations Plan *

Station to Station Links	Headway	2 hour Peak Seating Capacity	Peak = L. V.	85% Work Avg. L. F.
Antioch to Pittsburg	12 min.	7,200	3,447	0.48
Pittsburg to W. Pittsburg	"	7,200	6,067	0.84
W. Pittsburg to N. Concord	"	7,200	7,033	0.98
N. Concord to Concord	"	7,200	7,023	0.98
Concord to Pleasant Hill	4 min.	21,600	14,431	0.67
Pleasant Hill to Walnut Creek	"	21,600	17,293	0.80
Walnut Creek to Lafayette	"	21,600	23,337	1.08
Lafayette to Orinda	"	21,600	26,678	1.24
Orinda to Rockridge	"	21,600	27,815	1.29
Rockridge to MacArthur	"	21,600	28,637	1.33

* Concord - Daly City Line Capacity = 4 min.
Richmond/Fremont Lines = 8 min.

Source. Bart Offices of Planning and Research, 1975

ences between these two tests which affect this comparison are:

1) Test 3A assumes that residents of the Livermore and Pleasanton areas would use the San Ramon Corridor to reach the Lafayette Station, which inflates patronage from Lafayette westward and is an unlikely assumption.

2) The test 3A forecasts corridor use assumptions that are lower than those used in Test 5 and represent what this study feels is the most probably 1990 demand for BART service in the study corridor. These were the values used in determining added revenue from the extension. However, because Test 5 values are higher, providing a more severe test of "C" Line capacities with an extension to Antioch, and is not complicated by unlikely ridership from the San Ramon Corridor, it will be the forecast used in this analysis.

The unit of measure for these comparisons is the link volume. A link volume is defined as the total number of paying BART patrons aboard a train as it travels between two adjacent stations.

Table 6-3 indicates 2 hour a.m. peak period link volumes in the westbound direction for Tests 1A and 5, assuming that this patron movement is equal to 85% of the daily westbound work trips.

RTTPP Test 1A indicates that load factors will be less than 1.8. Therefore, without an extension and with improvements to present BART service, including 6 minute peak headways, no significant line capacity problems are expected.

RTTPP Test 5 illustrates the probable impact of a BART extension to Antioch on link volumes between the Concord and and MacArthur stations.

Here a 1.85 load factor would be approached between the Lafayette and Orinda Stations with the 2.0 load factor being reached between the Rockridge and MacArthur Stations.

Load factors could well be higher dependent on a range of interrelated variables, many of which cannot be determined at this time. One factor, uncontrolled growth, would have the largest single impact on "C" Line service. If a rapid increase in pressure for residential development within the large area served by the line were to be accommodated, the result would be a useage of BART commute service over and above that predicted in Table 6-3.

The relationship between growth and the ability of public transportation services to support that growth is becoming an increasingly delicate issue in the Bay Area. Its resolution is complex but can be achieved through better growth management techniques and improved coordination and planning both at a local and regional level.

Assuming that the figures presented in Table 6-3 are conservative, several alternative strategies for increasing passenger capacity on the "C" Line are possible:

Alternative Operations Plan: Among the alternative operating plans now being considered is one which would expand peak period service levels on the Concord/Daly City Line. This operating plan would provide four, rather than six, minute service on the "C" Line and eight minute service on the other two transbay lines.

Table 6-4 illustrates probable load factors on the Concord-Daly City line with an extension to Antioch, assuming these improved service levels.

Service on the Antioch to Concord line segment would remain at 12 minutes, while service on the Concord to Daly City segment would be provided four and six minute headways.

With this improved level of service, load factors would be greatly reduced remaining well below the critical 1.85 level.

Provide Additional Service: Another alternative which should be considered is to provide a BART rail shuttle from Concord to downtown Oakland which also would enable four-minute headways on this section of the "C" Line. This service will be made possible by completion of the third track in downtown Oakland which is being proposed in BART's current Capital Program.

In addition to these service and operations improvements, other policies and programs include:

Staggered Work Hours: Management policies which encourage staggered work hours for persons employed in downtown San Francisco and Oakland could expand peak commute periods and thus help reduce average load factors on the "C" Line.

Parallel Bus Service: Provision of parallel bus service in selected areas could increase overall corridor-tranist capacity during commute hours.

Section 7: Transit Yard and Systemwide Equipment

As part of the study of an extension to an existing rapid rail transit system, investigations were conducted into requirements for additional train storage and maintenance facilities, rolling stock, train control, propulsion power supply, and other systemwide equipment needed to support the extension. The underlying consideration in these investigations was that all new support facilities and systemwide equipment be coordinated and integrated with those same elements already functioning in the existing BART system.

The first part of this section discusses the need for a yard with the second part providing a description of total rolling stock requirements and systemwide equipment.

TRANSIT CAR YARD

At the present time, BART's operating plan for the Concord-Daly City line utilizes the Concord Yard, which is located just south of the Concord Station, for storage, service, and regular maintenance of all rolling stock required on that line. Trains dispatched out of the Hayward or Richmond Yards which may operate on the Daly City-Concord line do not return to the Concord Yard nor do trains dispatched out of Concord return to the other yards. In effect, the Concord Yard exclusively serves the Concord-Daly City line and, as an enlarged facility or in combination with another yard located on this line, would exclusively serve any extension to the line beyond Concord.

Since there is the possibility that there will eventually be an extension of BART into San Mateo County an evaluation was made of the effect of that extension on system yard requirements. It was determined that an enlarged yard or new yard in Central Contra Costa County would still be needed in addition to a yard in San Mateo County which would be necessary to provide storage and maintenance of equipment generated by that extension.

The Concord Yard currently contains enough trackage to effectively store 150 cars and has the capacity to be enlarged to provide storage for 170 cars. However, BART is not presently planning to expand to the maximum storage capacity. The service and inspection building has three tracks running through it, two of the tracks with two pits each and one two-car capacity floor track on which those maintenance operations not requiring a pit can be carried out. Recent experience has shown that this facility is large enough to handle regular service and maintenance for approximately 100 cars presently being stored at the yard, but that the additional work load required for the abnormal amount of maintenance on the new cars is pushing the facility operation to capacity.

Additional Yard Needs: The present long range BART operation plan is based on eventual two minute service into and out of San Francisco during peak hours. Though this will be the minimum headway in San Francisco for the foreseeable future, system automatic train control design criteria specifies an ultimate capability to operate in and out of San Francisco at one and half minute intervals between trains. These service intervals in San Francisco will result in minimum peak hour headways on the existing Central Contra Costa line of 6 minutes and 4-1/2 minutes respectively. Though it appears that the patronage estimated for 1990 on the extension can be handled with 12 minute headways between Concord and Antioch during the peak hours, the design of yard facilities along the Daly City-Antioch line should consider the ultimate 4-1/2 minute operating condition.

Listed below are the total number of cars required, including spares, for four different operational situations in 1990 on the Contra Costa line. The number stated includes both "A" and "B" or end and intermediate cars.

Once this data was developed but prior to the preparation of the final operating plan, a study was made of the feasibility of maintaining the Concord Yard as the only yard on the line.

Though the Concord Yard does have the potential to provide storage capacity for all vehicles needed on the Daly City-Concord line when minimum headways are 6 minutes, yard capacity will not be sufficient when headways drop to 4-1/2 minutes. Furthermore, even though the Concord Yard could be expanded within its existing yard boundaries to effectively store 170 vehicles, there was an apparent need to provide minimum effective storage for at least 68 more cars when the extension is completed and headways dropped to 4-1/2 minutes. To do this either additional properties adjacent to the Concord Yard must be taken or an additional yard site along the extension must be found. In reviewing the Concord Yard as affected by the extension, the following findings were made:

- If the Concord Yard were used as the only yard on the line, in order to operate effectively, it should be double-ended, that is, capable of receiving and dispatching trains from both ends. It is currently single-ended and would require major modification to effect this, including an extension to the yard of approximately 2,000 feet.
- In addition to the above, an additional 5,000 feet of track would be required beyond the existing 170 car capacity to serve the ultimate operating condition. This amount of space would not be available because the only vacant property south of the Concord Yard is committed for a new 128-unit subdivision to be built in the near future.
- The existing service and inspection facility would not be adequate for a yard storing all cars needed on the line.
- A significant number of "deadhead" train miles would be annually accrued if the Concord Yard were solely considered,

Table 7-1. Line Train Requirements

	No-PAX	No-PAX	With PAX	With PAX
	4-1/2 min.	6 min.	4-1/2 min.	6 min.
Cars required on line	162	147	207	172
Spares	24	15	31	19
TOTAL	186	162	238	191

resulting in additional yearly operating expenses. "Deadhead" mileage represents the distance between the yard and the point where the trains go into revenue service.

- Sites for yards in the Antioch area are now available and should be available for many years.

Based on these findings, it was recommended that an additional car yard be located along the extension.

Yard Functions and Layout: Preliminary criteria for the selection of a yard site was established by the BART staff as follows:

- Need to store more cars than 100 car capacity of Concord Yard. This was based on the requirements of the operating plan discussed in Section 6.
- A vehicle service and inspection facility with a 4-car pit capacity, and a two-car capacity floor track.
- Run-around track at service and inspection shop.
- Car cleaning platform adjacent to service and inspection shop
- A Maintenance-of-Way facility, of approximately 10,000 square feet, and an adjacent enclosed storage area of 4,000 square feet. The building will contain maintenance equipment for the rails, structures, and certain electrical facilities on the line.
- A car wash track.
- A combination Transportation Building and Yard Control Tower.
- Employee and automotive equipment parking areas.
- Flyovers or grade separated tracks if movements into and out of yard oppose main line track movements.
- Adequate internal and external access roads.
- Modified double-ended.

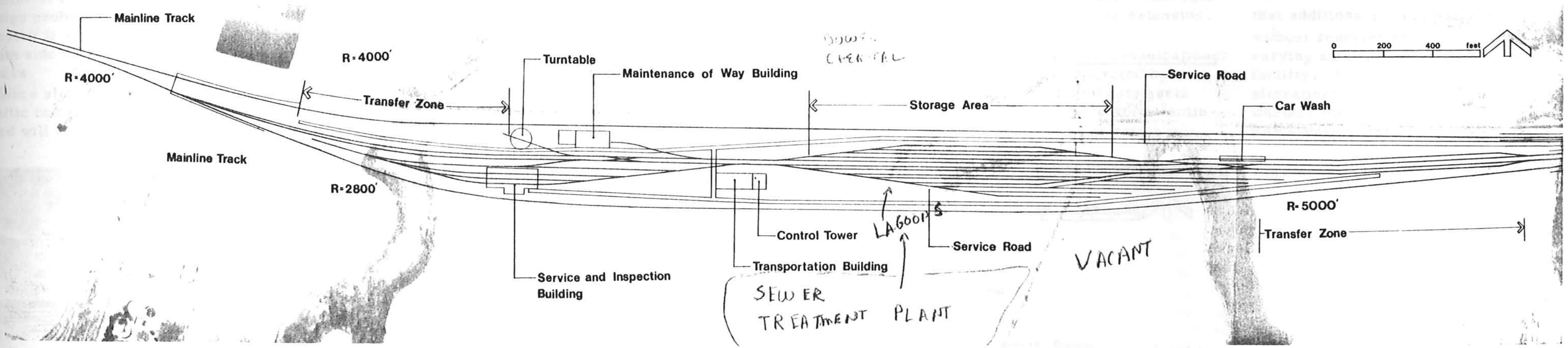
Evaluation Process: In determining acceptable alternatives for yard locations, evaluation criteria were used which included a combination of elements used for both line and station studies and operational and spatial needs peculiar to rail transit yards.

Due to the very size of a yard and the nature of operations occuring therein, its impact on the community in terms of redevelopment potential, relocation requirements, disruption to existing traffic and pedestrian patterns, noise, aesthetics, and land use are very important considerations along with possible impacts on the natural environment. Assuming that the yard must be located according to an acceptable operating plan, its impacts on the level of transportation service are normally negligible. Construction and right-of-way costs are also a major factor in comparing alternatives of such a large facility. Finally, the location of any yard site is most critically affected by how it fits into the operations of the particular line it serves and by the fact that the entire yard has to be essentially on a level or nearly level grade.

Yard Alternatives: The major function of the Central Contra Costa Line, with or without an extension, is to provide commuter service from the Central County areas into the East Bay and San Francisco in the AM peak hours and vice versa in the PM peak. Consequently, in the morning hours, a substantial number of trains must be dispatched from the eastern terminus as is pointed out in the operations plan discussion of Section 6. During the period between the peak hours, most of the trains that will be taken out of service due to reduced demand on this line will be stored at the Concord Yard. This is based on the need to dispatch these trains into San Francisco before the evening peak hours from the closest possible yards. And, finally, in the period between the end of the evening peak hour and the late night shutdown of the system, trains will be taken out of the system after dropping off passengers at the Antioch Station.

This operational setup created the need for a yard near the terminal station in Antioch. The ideal location for the yard is beyond the end of line since trains would not have to travel back on the line when they are taken out of service. A yard situated before the terminal station would require trains to travel on the main in-service tracks before being taken out of service. This could create potential problems because of the interference with trains still in service, especially during peak hour conditions when the headways are at a minimum. However, there are two methods of solving this problem: either grade separate the yard leads from the main line tracks if the yard is on one side of the main line tracks or place the yard in between the main line tracks.

Because of the location of the Antioch Station along the shore of the San Joaquin River opposite the central business district, it would be away from the rivers edge and the developed sections of Antioch and, therefore, into the area where the yard could be situated. Thus, it was in the area east of here that the search for a yard site took place. The conclusion of this investigation was that there were no sites south of the Atchison, Topeka and Santa Fe (ATSF) tracks, either undeveloped or partially developed, which were of adequate size and shape for a yard. North of the railroad tracks, the land is industrialized enough to make the right-of-way acquisition costs extremely high. The lack of available acreage, the high cost of simply extending the line to potential yard sites, and the impact of running the line along the river, resulted in a study of yard locations west of the Antioch Station. Locations both north and south of the ATSF tracks in the area just west of the developed portions of Antioch were considered The area south of the tracks was



SANITATION DIST. 7 - SPECIAL DIST - LLOYD GALLAGHER - MANAGER recommended because industry and related spur tracks on the north side would not allow enough distance in that area to fit in an at-grade yard and still permit the tracks to rise over the at-grade entrance to the cannery. The selected site to the south was also ideal in that it required no residential or industrial property relocation and because its location adjacent to the railroad and industrial land minimized its visual and noise impacts.

Recommended Yard Layout: The plan of the recommended yard is shown in Figure 7-1. The yard is located south of the ATSF tracks between sections of aerial structure which pass over active railroad spur tracks to the west and over a spur track and the railroad main lines to the east. It is also located between the BART mainline tracks to avoid additional costs and potential design problems which would occur if it were located on the south side of the BART mainline tracks.

Since almost all of the train traffic coming into or leaving the yard will travel by way of the Antioch Station, a four track transfer zone for switching trains from automatic to manual control and vice versa has been provided at the east end of the yard. Yard lead tracks have been provided to both of the main line tracks between the transfer zone and the station. At the west end of the yard only an eastbound or inbound lead track and a two-track transfer zone are provided from the eastbound main. This has been incorporated to allow trains that are not carrying passengers and those that are no longer in revenue service to enter the yard without having to travel to the Antioch Station first.

All the elements recommended by the BARTD staff, including a satellite control center, are contained in the yard. In addition, a turntable has been included to provide the flexibility of turning around "A" or end cars as necessary to makeup trains. Internal vehicular access within the yard, space for employee vehicles and other equipment, and outside storage have also been provided. Access into and out of the yard has been proposed by way of a road adjacent to the Fibreboard Corporation property at the east end of the yard.

SYSTEMWIDE EQUIPMENT

Once the final extension was selected and the more refined alignment and station site designs were completed in the initial stages of the second phase of the project, plans and sections were furnished to the BARTD staff to assist them in determining finally the following systemwide equipment needs for the extension:

- Rolling Stock
- Train Control and Communications
- Propulsion Power
- Service Power
- Fare Collection

Rolling Stock: This subject has already been discussed in the section on the transit yard. This was necessary since the total number of cars required to provide service during peak hours on the Central Contra Costa line determined the added storage requirements for that line.

Listed below in Table 7-1 are the requirements for both "A" and "B" on-line and spare cars needed at some time after 1990 to provide service on the Daly City-Antioch line in addition to those required for the operation of the existing Daly City-Concord line:

Table 7-2. Additional Rolling Stock Requirements

"C" Line Headways	On-Line Cars	Spares	Total
6 mins.	A - 12 B - 13	A - 3 B - 1	A -15 B -14
4-1/2 mins.	A -16 B -29	A -2 B -5	A -18 B -34

Based on the ultimate operating conditions with four and one half minute headways on the extension, a total of 52 extra cars would have to be purchased for the extension.

Train Control and Communications: BART trains are operated by a computer-controlled automatic train system. The system continuously receives information on the status of each train, compares it to planned operation, and adjusts station stops and train speeds to compensate for any deviations from the operating plan. Data from the trains and instructions to them are transmitted by wire communication circuits along the right-of-way. The central computer-control is located in the BART Administration Building in Oakland.

Train control and communications systems for the extension of transit from the Concord Station to Antioch must be compatible with the BART system to ensure fast, safe and reliable operations. One method to achieve this would require central supervision of the extension from the Lake Merritt Central Control which in turn would necessitate expansion of control hardware and reorganization of the system software. The present arrangements and capacities at BART Central Control are such that additions are not practical without removal and rebuilding of varying amounts of the present facility. The extent of necessary alterations would depend upon whether other extensions to the BART system would be in operation

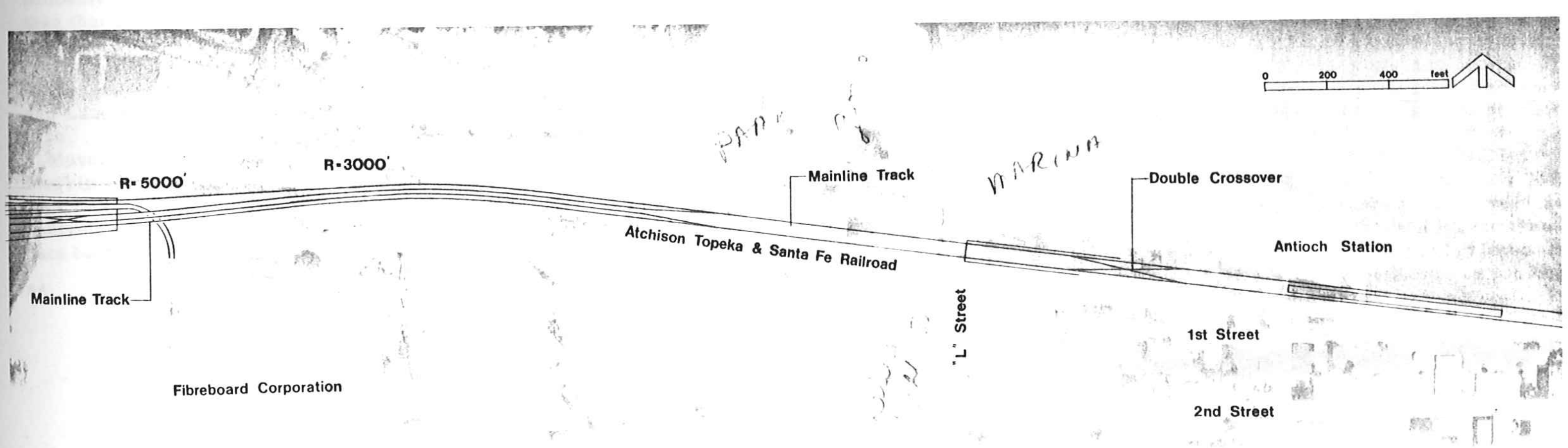


Figure 7-1. Transit Yard Plan

Service Roads ═
Buildings and Structures ▭
BART Track ▬

or planned at the time of the PAX extension. Reorganization of the software would result in alteration of the heirarchy of control execution and consequent increases in response times.

The jurisdiction of the existing Central Control can be interpreted as limited to the existing BART system; the complex of the Oakland and San Francisco central business districts, BART junctions adjacent to them, and their approach and dispatch sections. Its principal function is to govern operating stability in these nearly saturated areas, but the jurisdiction would not necessarily include extensions of the present system. They could be candidates for related but autonomous jurisdictions of their own.

Rather than rebuild the existing BART train control system, it is recommended that the system from Concord to Antioch operate as a separate jurisdiction with line supervision from a satellite central control located at the yard facility at Antioch. Though this decision must be re-evaluated when the PAX extension goes into design, it is the assumption used for this report since it represents the more costly and therefore, conservative approach. This satellite central control, here dubbed the PAX Central Control, will contain equipment similar to and perform the same functions as the Lake Merritt Central Control. The computer will probably be somewhat smaller than that at Lake Merritt. Data necessary for "hand-off" of trains in the Concord area will be exchanged between the Antioch and Lake Merritt central computers.

Movements between the Lake Merritt Central Control and the PAX Central Control can be controlled by the "hand-off" of data between jurisdictions. The PAX Central Control will interface with the equipment at Lake Merritt on a call-up basis. That is, train information will be passed to Merritt on a designated channel as called for to allow proper coordination of train "hand-off" between the two control areas. The "hand-off" will occur just north of the Concord Station, since at this location the requirement for intra-jurisdictional data is minimal.

Other communications equipment that could be located at the Antioch Yard are the private automatic branch exchange (PABX), the automatic call distribution (ACD) system for customer calls, the terminal for the emergency telephone system, and the maintenance telephone equipment. To guarantee proper maintenance and security communications from the Lake Merritt Central Control operation to the extension trackage and the Antioch Yard, a new maintenance radio base station will be required, probably on Mt. Diablo or on Kriger Peak near Antioch.

Propulsion Power: The design of the electrification substations, equipment requirements, cables and methods of installation for the extension will closely follow established procedures on BART. The design encompasses either one or two switching stations between the Concord and Antioch Stations to receive 34.5KV ac from PG&E and transform it to 1000 volts dc power and gap breaker stations located at points intermediate between the substations and in the yard. The number of switching stations will depend upon PG&E's existing distribution system. In the case of substations, they are normally located at one end of each passenger station and at the yard. However, extra ones are assumed for the PAX due to some rather large station spacings. The design will also include the 1000 volt dc cable distribution and contact rail system to train power collectors.

Service Power: Service power (auxiliary power) is required for the operation of passenger stations, the yard buildings, and line sections. This power could be obtained directly from PG&E, and could be a dual feed service with an automatic transfer switch and a utility company transformer. This power is required to operate such things as elevators, escalators, ventilation fans, all lighting, signing systems, fire alarm systems, sump pumps, closed circuit TV, door control systems, maintenance shop and train control equipment.

Fare Collection: Fare collection equipment for an extension of rail rapid transit between existing Concord Station and the proposed Antioch Station are based on the following assumptions:

- The types of equipment are identical to those used for the design of the original BART stations, except that the function of change making will be combined with the fare vendors in the free area and with the add fare machines in the paid area.
- Each station will have one centroid and therefore one pay area, with one group of gates in an uninterrupted line.
- Each station will have a minimum of one service gate available for use by the handicapped.
- Special facilities for handling large suitcases and packages are to be provided.
- Initial equipment quantities are based on patronage forecasts for 1990.

Equipment quantity estimates presented in Table 7-2 were derived from patronage estimates for the extension stations. Arrival curves based on transit arrival patterns in the San Francisco - Oakland area were utilized to determine a peak 5-minute boarding and alighting factor, which was then used to convert total daily boardings and alightings at each station to peak 5-minute flows. For the extension, this factor, which is currently used for BART planning, is 0.045. Having the 5-minute peak boardings and alightings, the fare collection equipment required for each station was determined.

Table 7-3. Fare Collection Equipment Estimate

Station	Gate Aisles	Consoles	Fare Vendors	Add Fare Machines	Agents' Readers
			(with money changers)		
N. Concord	4	5	3	2	1
W. Pittsburg	4	5	3	2	1
Pittsburg	6	7	7	2	1
Antioch	6	7	7	2	1
TOTALS	20	24	20	8	4

Section 8:
Fares, Revenues, Operating Costs, and Capital Costs

To help determine the economic feasibility of extending rail rapid transit into the Pittsburg-Antioch corridor it is necessary to estimate the gross revenue it will produce and compare this to the costs of its operation. The revenue produced by the rapid transit extension to Antioch will consist primarily of the passenger fare collected during the year based on the fare structure used and the patronage attracted. Transit patronage in turn will depend on the fare schedule, level of service provided, and travel times. This interaction between the fare schedule, level of service, travel times, and patronage has been considered in the development of patronage and revenue estimates.

The operating costs are those expenses involved in the actual operation of the trains and maintenance of all equipment. The difference between the annual gross revenue and operating expense will be the net revenue produced by the extension. However, net revenue is difficult to project because of the interrelationship between level of service provided by the system, operating costs, fare structure, patronage, and the effects of inflation.

This section will discuss the fare structure, projected gross fare revenue, operating costs and net revenue.

FARE STRUCTURE

The assumed fares for these estimates are based on the present BART fare schedule which was adopted on December 20, 1971. The BART Board of Directors is currently considering revisions to the fare structure which, if approved, may modify the information in this section. The present fare structure is based on distance traveled and scheduled travel speeds. Longer trips are charged more than shorter ones,

Table 8-1. Fares Between Extension Stations and Selected BART Stations

	Antioch	Pittsburg	West Pittsburg	North Concord	Concord	Walnut Creek	MacArthur	Berkeley	Richmond	12th Street-Oakland	Fruitvale	Hayward	Fremont	Montgomery	24th Street Mission
Pittsburg	$.30														
West Pittsburg	.30	$.30													
North Concord	.30	.30	$.30												
Concord	.65	.55	.35	$ .30											
Walnut Creek	.90	.75	.55	.40	$.30										
MacArthur	1.20	1.10	1.05	.90	.85	$.65									
Berkeley	1.15	1.05	1.00	1.25	.85	.65	$.30								
Richmond	1.20	1.15	1.05	1.05	1.00	.65	.45	$ .40							
12th Street-Oakland	1.20	1.10	.95	.95	.90	.65	.30	.30	$.50						
Fruitvale	1.20	1.10	1.05	1.00	.90	.70	.30	.35	.55	$ .30					
Hayward	1.25	1.20	1.15	.95	1.05	1.00	.65	.70	.90	.60	$.50				
Fremont	1.45	1.40	1.30	1.25	1.25	1.15	1.00	1.00	1.10	1.00	.90	$.65			
Montgomery	1.45	1.35	1.30	1.25	1.20	1.10	.60	.65	.85	.55	.65	1.00	1.25		
24th Street Mission	1.45	1.35	1.30	1.25	1.20	1.10	.65	.70	.95	.60	.70	1.05	1.25	$.30	
Daly City	1.45	1.35	1.30	1.25	1.20	1.15	.75	.85	1.00	.75	.80	1.10	1.25	.35	$.30

How To Use This Table:
Each station name on this table identifies both the row of numbers under it and beside it. To find the fare for any trip, first locate the station where you plan to go. Trace down the row from one name, across from the other, and find your fare where the two rows come together.
Example: West Pittsburg to Montgomery St. is $1.30

Special Fares:
(1) Children 4 yrs. and under ride free.
(2) 75% for children 5-12 years of age.
(3) 90% Discount to Senior Citizens. Excursion Trips of up to 3 hours in length cost $1.00 per round trip.
(4) 75% discount to handicapped.
(5) 75% discount for Junior and
(6) Senior High School field trips.

and faster scheduled trips are charged more than slower ones of the same distance. The fares for all trips are calculated according to a standard formula which systematically accounts for distance traveled and scheduled speed. The components of this fare schedule formula are as follows:

(1) A maximum fare of .30¢ for trips up to six miles.

(2) A uniform rate of .35¢ plus .03¢ per mile for trips from 6 to 25 miles.

(3) A rate of .92¢ plus .01¢ per mile for trips over 25 miles.

(4) A uniform surcharge of .15¢ for trans-Bay trips.

(5) The scheduled travel time between any two stations is compared with the time required for that trip at the system's average speed and the difference is priced at .02¢ per minute. The distance-based fares are lowered for slower than average trips by .02¢ per extra minute, and increased by .02¢ per minute saved for faster trips.

(6) All fares are rounded to the nearest .05¢.

The fares for trips between extension stations and major Bay Area destinations are shown in Table 8-1.

PROJECTED GROSS REVENUE

The extension revenue projections for 1990 were derived by multiplying projected patronage volumes at the four extension stations by the average fare of the trips that were forecast from them.

The gross incremental passenger revenue attributable to the extension to Antioch estimated for 1990 is $8.8 million. This is based upon an estimated annual incremental patronage of 7.9 million passenger trips and the existing BART fare schedule. This estimate reflects passenger revenue only and does not assume income from parking charges, advertising, etc., nor the costs of feeder bus transfers or other interagency agreements.

The patronage and revenue cited above are derived from 1990 patronage estimates from the Regional Transit Travel Projections Project (RTTPP). This project is described in Section 6 of this report. The 1990 total patronage level of 10.6 million annual passenger trips on the extension produces a gross revenue estimate of $11.9 million per year.

OPERATING COSTS

Operating costs of a rapid transit system are those expenses involved in the actual operation of the trains themselves and in maintaining associated equipment. The major portion of those expenses is made up of wages, salaries and overhead costs for personnel such as, train operators, station attendants, security police, janitors, maintenance personnel and supervisors. Power and utilities, insurance and supplies are additional items included in operating cost estimates.

The incremental annual operating cost of the extension is estimated to be $6.5 million per year in 1974 dollars as shown in Table 8-2. These incremental operating costs are based on BART's current operating experience and the operations plan developed for this extension. The figures are shown in 1974 dollars to be consistent with the fare schedule used to project extension revenues. Inflation will undoubtedly result in increased costs by the time the extension is approved for construction and, to the extent that fares are changed to match, revenues would also be relatively higher.

BART officials have pointed out that operating costs alone do not represent a true picture of BART incremental cash requirements brought on by the extension. Two other items must logically be increased when the system is expanded. These are an annual allowance for purchasing new cars to meet expanding patronage demand and an allowance for the replacement of minor capital equipment and other system improvements.

NET REVENUE

The difference between estimated incremental operating costs of $6.5 million and estimated incremental gross revenue of $8.8 million yields a possible net revenue of $2.3 million dollars. This net $2.3 million, like all other estimates is in 1974 dollars and does not reflect the effect of inflation on costs or fares. Based on recent trends, inflation rates of 6 to 10 percent per year on operating costs are possible; likewise, fare increases, although possible, cannot be predicted.

Dependence of the possible net revenue estimate on fare structure and cost assumptions, as well as patronage projections makes the numerical value presented herein tenuous. However, since the assumptions used were based on the best information available, the resulting projection of revenues and operating costs indicate that a net $2.3 million can be expected from this extension to Antioch.

CAPITAL COSTS

The costs presented in this section represent the total cost in mid-1974 dollars for designing, constructing, and making the extension ready for operation. The level of preciseness of the estimates reflects the degree of detail that was developed in the preparation of the engineering for the line, yard, and systemwide equipment designs. Correspondingly, the order of magnitude of the estimate was the basis for determining the percentage assigned to the contingency value. A brief description of the elements included in each item listed in the construction cost estimate is included below:

- Right-of-Way: The estimated acquisition cost of all public and private property needed for the extension was established by local specialists experienced in the appraisal of property and familiar with local real estate value trends. The cost includes all relocation expenses and BART's share of right-of-way expenditures for the joint use sections in Port Chicago Highway and State Route 4. However, it does not include costs involving property purchase and damages that may be incurred by excessive noise impacts on adjacent properties along Port Chicago Highway in Concord or 8th Street in Pittsburg.
- Civil and Structural - Line: Costs to construct the transit structures between stations including related costs such as site preparation, street relocation and restoration, fencing, traffic maintenance during the construction

Table 8-2. Estimated Annual Incremental Operating Costs/Revenues

TABLE 3

Item	Labor Cost	Non-Labor Cost	Total Cost
Maintenance (1)	-	-	$2,955,000
Transportation (2)	1,700,000	14,000	1,714,000
Power	-	705,000	705,000
Police Services	285,000	53,000	338,000
Revenue Collection	74,300	5,500	79,800
Subtotal			5,791,800
Insurance @ 2% (3)			118,200
Subtotal			5,910,000
Contingency @ 10%			591,000
Total Annual Operating Cost			6,501,000
Incremental Operating Revenue			8,800,000
Net Revenue			2,300,000

(1) Approximate estimate.

(2) Costs include; central operations (manning of satellite control, center at Millsdale Yard); yard operations; line supervision; station operations; train operation.

(3) Approximate estimate.

Source: Bay Area Rapid Transit District, Feb., 1975.

period, and utility and railroad relocations are combined in this element.

- **Utilities and Agreements**: Costs in this item are incidental to the relocation of utilities by the owners before transit construction and include costs incurred by the utility agencies and chargeable to BART. Electric power distribution, communications, gas, water, sewage and storm drainage are affected.
- **Landscaping - Line and Station Structure Contracts:** Costs of topsoil, fine-grading, trees, shrubs, and ground cover, their planting and initial maintenance, and irrigation systems.
- **Architectural and Structural - Line Stations:** Costs of all station structure construction including finish work.
- **Specialty Contracts**: Street furniture and signs, station agents' booths, escalators and elevators, but not fare collection equipment.
- **Parking Facilities**: Costs of constructing park-and-ride lots and associated kiss-ride and bus areas, including site preparation, storm drainage systems, paving, landscaping, signing, and lighting.
- **Yard and Shops**: Shop buildings and related structures, all grading and paving required including access roads, fencing, major equipment, and lighting.
- **Procurement Contracts:** Furnishing of mechanical, electrical, and miscellaneous equipment to maintain conformity and obtain economy through volume purchasing.
- **Trackwork - Line and Yard Contracts:** All costs for switches, rail, ties, ballast, and fasteners, and their installation.
- **Electrification**: Costs of the electrical system to furnish power for train propulsion and control, including utility connections, sub-stations, third rail, and incidental electrical facilities.
- **Train Control & Communications:** All costs of the automatic train control system, including a satellite control center and interties with Lake Merritt Central, and all costs of other communication systems.
- **Fare Collection Equipment:** Consoles, ticket vendors, money changers, addfare machines, and agents' readers.
- **Rolling Stock**: Cost of the additional rolling stock initially required by the extension.
- **Pre-Operation and Testing:** Costs of planning operations, recruiting and training personnel, maintenance and security, and testing of the extension prior to revenue service.
- **Insurance**: Premiums for comprehensive liability coverage. Workmen's compensation insurance is included in architectural, civil, and structural costs.
- **Engineering and Construction Management (E&CM):** Fees for architectural and engineering services and construction management costs. These are estimated at 12 percent of construction cost except for right-of-way for which costs relative to property acquisition, demolition of existing improvements, title investigations, appraisals, negotiations, legal expenses and weed abatement are included in the right-of-way cost. Also excluded from construction cost are the cost of rolling stock and insurance.
- **Contingencies and Miscellaneous:** A contingency of 14 percent of the sum of all costs including E&CM.

Table 8-3. Construction Cost Estimate (Concord to Antioch)

Right-of Way	$ 7,775,000
Civil and Structural-Line	60,400,000
Utilities and Agreements	4,700,000
Landscaping	2,700,000
Architectural and Structural Line Stations	9,000,000
Specialty Contracts	1,720,000
Parking Facilities	1,656,000
Yard and Shops	4,033,000
Procurement Contracts	1,500,000
Trackwork	13,051,000
Electrification	14,374,000
Train Control and Communications	9,410,000
Fare Collection	2,068,000
Rolling Stock	25,000,000
Pre-Operation	1,200,000
Insurance	4,200,000
SUB-TOTAL (1974 dollars)	$162,787,000
Engineering and Construction Management	16,030,000
SUB-TOTAL	$178,817,000
Contingency	$ 25,183,000
TOTAL COST (1974 dollars)	$204,000,000

TABLE 2

Section 9: Potential Financing

The most crucial consideration affecting the eventual implementation of the BART extension may be the manner in which it can be financed.

The two categories of cost involved in rail transit improvements; operating and capital costs, were discussed in the previous section. It has been calculated that the annual operating costs of the additional service would be $6.5 million and the revenues, $8.8 million.

Capital costs, which are the expenditures required to acquire right-of-way, to design and construct the extension, and to purchase systemwide equipment to operate the line, have been estimated at slightly over $200 million as of 1974. The actual total capital cost will depend upon when the extension is built, how long the design and construction takes and the method of financing.

Throughout the report, and especially in Section 10, evidence has been presented about the social, transportation, environmental, and potential economic benefits of the proposed BART extension. To make the final decision on whether to extend BART or not, these benefits must be weighed against the construction and operating costs of the proposed extension to Pittsburg and Antioch.

The sources of money to finance the extension are not conclusive at this point for several reasons:

(1) poorly defined funding mechanisms for transit;
(2) changing attitudes and policies toward funding transit;
(3) Uncertainty of the position of the region in competing for federal dollars;
(4) Priority of the proposed corridor improvement within the region; and
(5) Equity of transit improvements.

FUNDING MECHANISMS

Unlike highway projects, there is no simple assured source of funds for transit projects. Transit planners and decision-makers are generally faced with the problem of preparing plans in order to sell someone on the necessity of financing the project. The PAX project is no different; the plan or program must be developed in order to advocate the development of a financial plan using a variety of fund sources.

The sources of funds that have been used to finance transit capital in the Bay Area include:

Local Funds:

1) Property Taxes: used by San Francisco Muni, AC Transit as the major source of operating funds. BART construction is partially financed by $792 million in bonds financed from property taxes. These bonds will be retired in 1999. Voters are increasingly reluctant to approve property taxes for major new projects; therefore, further property taxes are an unlikely source for capital funding, particularly for extensions of BART within the existing BART three counties.

2) Sales Tax: Currently BART finances $150 million dollars in bonds for construction from a special 1/2¢ sales tax levied within the three BART counties. These bonds will be paid off in 1975; however, this tax will continue as a source of BART operating funds until 1977. It is uncertain whether sales taxes will still be a funding resource when PAX is implemented, although the Metropolitan Transportation Commission is recommending that the State enable the counties to authorize the implementation of up to a 1¢ sales tax for allocation by the Metropolitan Transportation Commission for transportation purposes.

3) Bridge Tolls: The Golden Gate Bridge, Highway and Transportation District is using bridge funds to finance both the local share of the capital and the operating deficit of its bus and ferry system. Funds from the three San Francisco Bay bridges (San Francisco-Oakland, San Mateo-Hayward, and Dumbarton) were pledged to support BART's bay tube. The Metropolitan Transportation Commission has taken the position to continue "its present efforts to secure legislative authorization to use surplus bridge toll revenues for transit purposes on an equitable basis."

State Funds:

1) Transportation Development Act - In 1972 the State made funds available for transit by means of extending the general sales tax to gasoline and providing the equivalent of 1/4 cent from the sales tax proceeds for transit. These funds, allocated by MTC, are restricted to use in their county of origin. All transit agencies are currently using these funds for both capital and operating costs. These funds are the most likely known source for most minor capital projects, including the purchase of vehicles. While TDA monies can be used for bonds, the pressure on this source for use in meeting ongoing operating expenses by local bus operators would seem to rule against TDA as a single source for major projects.

2) Proposition 5 - This measure, approved by voters in July 1974 makes up to 25% of existing State highway resources available to transit. Potential uses of these funds include construction and improvements to public transit fixed and related facilities, right-of-way acquisition and administrative costs. Diversion of these funds for other than planning and research projects, requires county-wide voter approval. Contra Costa is the only BART District County which, to date, has not taken steps to place this issue before its voters.

Federal Funds:

1) Urban Mass Transit Aid - The National Mass Transportation Assistance Act (1974) amends the Urban Mass Transportation Act (1964) to provide funds for both capital and operating assistance through its two basic provisions.

(a) Section 3 of the Act provides funds for capital projects at the discretion of UMTA on an 80% Federal to local matching formula.

(b) Section 5 provides both capital and operating assistance for the transit operation. Capital assistance provides much the same as Section 3 funds. Operating assistance, however, is apportioned based on a 50/50 Federal-local matching formula which considers population and population densities above and below the 200,000 level.

The PAX extension provides the unique opportunity to tap the resources of both the Oakland-San Francisco area (which includes Concord) funds and those allocated for use in the Pittsburg-Antioch area with its population below the 200,000 benchmark. This transit project, serving and operating in both areas, would conceivably qualify for funds under both sets of criteria.

The problem remains that there is not presently a sufficient amount of Federal funds to match all projects currently being developed. Nonetheless, the use of Federal dollars will play a significant role in any major project developed for the PAX corridor.

2) Federal Aid Highway Funds: BART is building two transit finger parking facilities using 90% federal Interstate Highway funds. BART also has other projects proposed for financing by Federal Aid Urban (FAU) highway funds. This is a new provision of the Federal Highway Act which makes funds available for both urban highways and transit (including rolling stock), nominally on a 70% federal, 30% local basis (actual matching is close to 83%, 17%). A logical use of the funds would be for all street and traffic improvements related to transit.

CHANGING ATTITUDES AND POLICIES

BART began in an era when no federal or state funds were being allocated for transit. The federal government now provides about $1 billion dollars annually for transit capital projects. This amount is not sufficient for the Urban Mass Transportation Administration to guarantee full 80% participation in all of the major rail transit projects in progress or proposed. As a practical matter most UMTA funds will probably be used for operations and perhaps some minor capital programs or bus replacement. A total of $7.825 billion over six years will be allocated by the Secretary of Transportation. The amount of federal funds for major capital projects in this region remains a function of both the competitiveness of our plans and the total availability of federal funds.

Another trend in federal legislation is the increasing use of traditional highway funds for transit projects. The Federal Aid Highway Act actually permits diversion of Interstate Highway funds and the use of Federal Aid Urban funds (a new aid category) for transit. This trend should continue and be expanded upon in future legislation.

The state, on the other hand, has not participated directly in financing specific transit projects. The state, however, has made funds available through local mechanisms for transit purposes.

In 1972, the state made funds available for transit by means of extending the general sales tax to gasoline and then providing the equivalent of 1/4 cent from the sales tax proceeds for transit. These funds, known as "Transportation Development Act (TDA) Funds" are allocated by the Metropolitan Transportation Commission.

Other state programs such as state participation in the construction of fringe parking and other facilities for transit, diversion of bridge tolls, or new taxes - particularly energy related - for transit purposes have the possibility of state support. These changes will be facilitated by the strong support of the MTC.

Regional Priorities

The regional priorities for this project will be determined by the Metropolitan Transportation Commission. The PAX study, one of several being undertaken cooperatively with MTC, is part of a process for making that determination. The trend in funding which allows for greater flexibility in the use of funds from different sources places a much higher level of responsibility within the decision making process than previously existed. This study was designed to assure participation from the community and decision makers who will be required to implement the plan. Continued support of these participants is essential if the selected improvement is to be made part of the regional plan and have a high priority for funding.

system, including any extension into the county.

Equity Considerations

Proposed BART extensions outside the BART District raise issues regarding the equity of the local taxpayers who have supported over 80% of the cost of the BART system, and these considerations are a significant regional issue. Proposed extensions also provide a potential partial source of new capital funds for the BART District.

The existing BART Act indicates that taxpayers in a county that joins the system would have to share some portion of that burden. The exact sharing of costs which would be the subject of extensive negotiations raises several complex issues which are discussed fully in the final report of the San Francisco Airport Access Project by Parsons Brinckerhoff-Tudor-Bechtel, Wilbur Smith and Associates, and Kirker, Chapman, October, 1972.

Applying the approach suggested by the BART Act to cost sharing, if an extension were built to San Mateo County, the County would assume roughly 22% of the cost of the full regional system, including any extension into the County. Because federal funds would be available to fund 80% of the extension, there would be a surplus of funds available to construct additional projects within the BART District, to lower existing BART taxes, or some combination.

Conclusion

Preliminary review of fund sources indicate that a BART extension in this corridor is within the region's financial capability although no specific plan is presented here. In fact, because attitudes and policies toward financing transit are changing the development of plans, such as this one for PAX, should not be inhibited by past funding constraints.

What is required is an overall plan of priorities for funding major capital improvements in the region. Both MTC and the State Legislative Analyst, are reviewing transit fund sources. This work will undoubtedly be well underway or complete by the time this report is submitted to UMTA for its approval. With this information and information developed from other planning efforts both at a regional and project level - it will be possible to develop a realistic approach to a financing proposal. When this work is complete, the project staff, in cooperation with MTC, will submit a follow-on report.

Section 10: BART, No-BART Comparison

A substantial commitment of funds will be required to extend rapid transit service to the Pittsburg and Antioch areas. If this extension is going to be considered as a necessary and feasible means of providing for future transportation needs as well as a catalyst for shaping future corridor growth its benefits must be shown to justify the expenditure. It is the purpose of this section to examine and compare system capital and operating costs, service characteristics, environmental impacts, community impacts, local government costs, air quality, and energy requirements of extending BART to Pittsburg and Antioch (BART Future) with the option of not extending BART beyond Concord (Limited or Trend Growth Future).

One of the basic issues of Extending BART versus Not-Extending BART to Antioch concerns itself with how and at what rate growth should occur. It now appears fairly certain, that if BART is not extended, growth within the corridor will be limited (see figure 10.1). The following discussion emphasizes some of the implications of more recent policy changes which serve to reinforce this statement.

CORRIDOR GROWTH

Since the beginning of this study significant changes in the national and local economy have taken place; energy shortages and uncertainties, the rapidly increasing cost of automobile purchase and maintenance, increasing building costs and limited investment capital have all contributed to a general slow-down in growth in the Bay Region which has in turn impacted the Pittsburg-Antioch corridor.

Some of these changes are permanent in nature and have combined to modify existing trends. Thus, without a BART extension, the picture of a "Trend Future" as described in Section 4 of this report would now appear to be out of date. Yet, many of the policies, goals and decisions which are presently being made by local jurisdictions in the corridor reflect a situation similar to many of the pre-BART growth commitments previously mentioned: pre-commitments including preservation of open space and agricultural lands, urban limit lines, extension of utilities only to areas already committed to development and efforts by cities to attract development and redevelopment opportunities directed to stabilizing downtown areas. However, the permanence and effectiveness of these controls and the effects of the aforementioned economic situation remains to be seen. The Pittsburg-Antioch area has to date witnessed little economic expansion. The area is now on the urban fringe and will come under increasing pressure for development as land costs rise and housing rapidly reaches a premium in other parts of the Bay Region. The availability of relatively inexpensive land, low cost home buys, nearby recreation, good climate and express bus service to the Concord BART Station will make development an attractive proposition. However, with this future, corridor growth would to a large extent be limited by the existing road network. Expansion of SR-4 would greatly improve access in and out of the corridor and thus facilitate corridor growth, but that expansion now appears unlikely.

1975 Environmental Protection Agency Regulations provide for very specific Environmental Impact Report requirements, especially relative to air quality standards, as well as review procedures which will make it increasingly difficult to gain approval of any major new roadway or improvement to an existing facility within a realistic time frame. In addition, funding for SR-4 appears unlikely in view of the low priority consideration given to that facility by the California Department of Transportation and the Metropolitan Transportation Commission (MTC). Also, construction of new shopping centers, office buildings and employment centers or additions to these facilities necessitating increased parking and access would be subject to the same regulations and procedures. In this event, No-BART would realistically represent a limited growth future.

BART FUTURE:

It is assumed that with a BART Extension from Concord to Antioch the corridor will reach a population of 374,000 persons which is considerably more growth than with the "No-BART" Future (282,000 persons). BART would also provide the market and opportunity for developments which would not otherwise exist within corridor communities. New growth directed by the proper governmental controls will be focused back into already built-up areas within the corridor providing for conservation of open space and rural lands, thus

Figure 10-1. Components of Corridor Futures

		Land Use			Transportation						
		Development Pattern			Modes				SR-4		
		Scattered	Spread	Clustered	Auto	Local Bus	Express Bus	Rail Transit	Exist.	Exist. w/Modif.	New 3-T-3
No-BART Future	Limited Growth (282,000 pop.)	●			●	●	●		●	●	
	Trend Growth (350,000 pop.)	●	●		●	●	●				●
BART Future	Concentrated Growth (375,000 pop.)	●		●	●	●		●	●	●	

3-T-3 = 6 automobile lanes with 2 bus transit lanes in median.

Note: 1970 corridor population was 212,000 persons.

encouraging the kind of clustered growth patterns public transportation is best suited to serve.

Regional policies emphasizing regional distribution of growth into corridors served by transit would support the higher growth assumption associated with the BART Future.

NO-BART FUTURE:

The non-extension option, in terms of regional growth and development, is essentially the picture of an area continuing to experience slow growth in presently undeveloped areas, with some redevelopment in older communities. Transportation in the corridor could consist of an upgraded version of the BART "Express Bus" system which is presently in operation between Brentwood, Oakley, Antioch, Pittsburg, Martinez and the Concord BART Station. Improvements to SR-4 necessitated by increased growth and traffic demands could range from interchange improvements only, to the addition of exclusive freeway median busways in addition to these interchange improvements.

Within the regional growth context of the non-extension option two alternatives were examined each assuming different levels of growth and transit service. The two bus alternatives presented are consistent with the assumptions and patronage data generated during the Regional Transit Travel Projections Project (RTTPP).

Bus Alternative 1a: The present BART "express bus" system would be up-graded providing better local and express bus service to the Concord BART Station. Corridor growth would represent a "limited" version of the "trend" with a 1990 corridor population of about 282,000 persons. No major improvements to SR-4 were assumed.

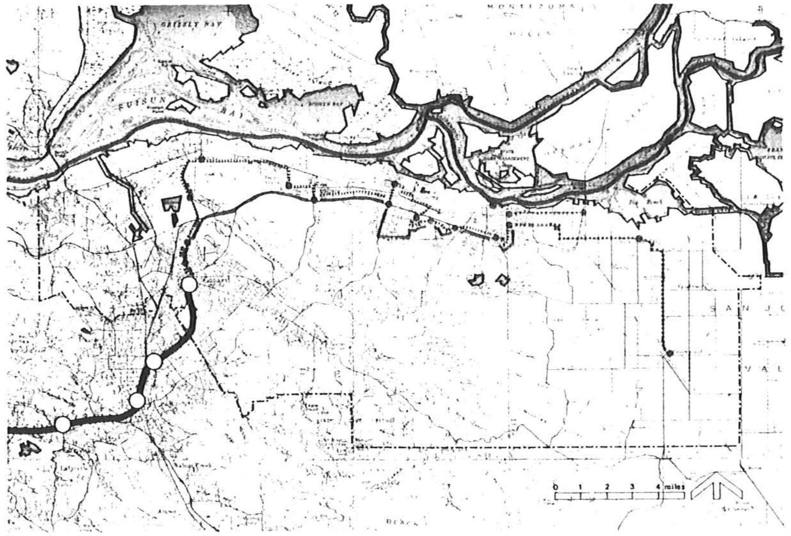


Figure 10-2 Existing BART "Express" Bus System

—— Peak (Express) Service	—— Existing BART Line
········· Basic Service	O BART Station
······· Limited Service	
● Bus Stop	

Bus Alternative 1b: This alternative would feature a higher level of bus service operating over the same routes. Expansion of SR-4 would include at least 6 vehicle lanes and, in addition, 2 exclusive bus lanes. Corridor growth would closely approximate the "trend" described in Section 3 of this report, resulting in about 350,000 people living in the corridor by 1990. It should be emphasized that this alternative is presented as a 'theoretical' future which in all likelihood would not occur without major regional policy changes concerning highway funding and environmental acceptance, as outlined in the preceding discussion on corridor growth.

Both Bus Alternatives use the present BART "Express Bus" program route structure as a basis.

EXISTING SYSTEM DESCRIPTION

In December 1974, BART initiated bus service from Brentwood, Oakley, Antioch and Pittsburg to the BART rail transit station in Concord. This service, which is being provided by AC Transit under contract to BART, was established mainly to provide patrons of the Pittsburg-Antioch-Oakley-Brentwood and areas of Contra Costa County not directly served by rail transit with adequate public transportation to BART. Three types of bus services are being offered; "basic", "peak" and "limited" service. Although the "basic" and the "peak" service are on different routings, both serve the corridor between the Port Chicago Highway and State Route 160. The "limited" service serves Oakley and Brentwood.

The "basic" route provides service during the weekdays on 60 minute headways during the hours between 5:30 AM and 9:00 PM. The "peak" route provides service during the weekday peak hours and in conjunction with the "basic" service provides at least 30 minute headways between 6:00 AM and 8:00 AM and between 4:00 PM and 6:00 PM. The "limited" route operates during the weekdays with two buses scheduled in the morning and two buses scheduled in the afternoon.

The "basic" route runs on the local streets of the industrial area east of Antioch, Pittsburg, West Pittsburg and the Shore Acres community and on Port Chicago Highway. The total travel time to the Concord BART Station is about 66 minutes.

The "peak" route runs on the local streets of Antioch and Pittsburg on State Route 4 west of Pittsburg and on Port Chicago Highway between State Route 4 and the Concord BART Station. The total travel time is about 46 minutes.

The "limited" route runs on State Route 4 from downtown Brentwood and downtown Oakley to Antioch and continues to the Concord BART Station on either the "basic" or "peak" route depending on the time of day. The total travel time between Brentwood and Antioch is about 20 minutes.

1990 BUS SYSTEM

For the purpose of this report it is assumed that the 1990 BART express bus system will represent an expansion of existing service by increasing the days and hours of service, the number of routes, by decreasing headways and/or lengths of existing routes. The extent of the 1990 bus network will depend upon the actual amount and pattern of new growth that occurs within the corridor. Route extensions and alterations will be made in

Table 10-1. 1990 Bus Network Service Characteristics

Type of Service	Days & Hours of Operation	Headways
Basic	7 days/week - 5:00 am to 1:00 am	30 - 60 mins.
Peak	Monday thru Friday peak hours*	15 - 60 mins.
Limited	Monday thru Friday, 5:00 am to 7:00 pm	30 - 90 mins.

*6:00 am - 8:00 am
4:00 pm - 6:00 pm

Source: PBTB-WSA

accordance with the demand for service (see figure 10-2).

(1) Line #1 - Basic Service: Presently these routes provide local inter-city service and non-express service to the Concord BART Station throughout the day. As the bus system expands and more express routes and smaller headways are provided, BART rail patrons could be expected to use the more rapid express routes during peak hours. However, the basic service will still be used for local trips and for trips to and from the Concord Station during off-peak hours. Therefore, this route will be the same as the existing basic route but with decreased headways.

(2) Line #2 - Express Service: Based on increased patronage in 1990, express routes will have shorter lengths of local service and decreased headways. For this line, it is assumed that the express route will be the same as the basic route until it reaches Loveridge Road and SR-4. At this interchange it will enter SR-4 and follow a normal express service route to the Concord BART Station, including stops at various other interchanges along SR-4. The total travel time would be about 55 minutes - less if exclusive bus lanes were provided on SR-4.

(3) Line #3 - Limited Service: Changes to this service to meet increased ridership demand would be similar to revisions made to basic service, principally involving decreasing headways on the same routes. Since this route provides both local and BART feeder service during non-peak hours, some mid-day runs will be added.

Bus in Freeway Operation: Reductions in travel times below levels possible with the private automobile would be a major inducement to increased bus ridership. The travel time for the basic bus service operating between Antioch and the Concord BART Station does not compare favorably with an automobile trip which could take as little as 30-35 minutes. However, express bus service, which has less circuitous routings, fewer stops and direct bus loading/unloading zones at the Concord BART Station entrances, compares favorably with the total trip time by automobile including parking.

To offset the convenience provided by the private automobile, further reductions in bus travel time would be necessary. Preferential ramp treatment, exclusive lanes, either continuous or intermittent, and separated busways are alternatives which might be considered.

Table 10-2. Regional Transit Travel Projections Project

Test	Daily Trips on Express Bus	ADT on SR-4	Vehicle/Lane Peak
1a	7,600	48,100	1,675
1b	11,700	61,700	1,515

Antioch - W. Pittsburg

Source: Regional Transit Travel Projections Project, Wilbur Smith and Associates, June, 1974.

Although the scope of this report did not include an in-depth analysis, some general options were examined. In order to determine various 1990 travel volumes by mode, within, into, and out of the corridor, the Regional Transit Travel Projections Project (RTTPP) ran two tests, each assuming different growth projection levels in the absence of a BART rail extension. The results of these two tests provide a comparison between the total daily trips made on the express bus system and the maximum average daily traffic level on SR-4 between Antioch and Willow Pass (see Table 10-2).

For Test 1b conditions, a widened SR-4 was assumed. Improvements include at least six lanes for automobile and truck traffic and two exclusive bus lanes. These improvements have been estimated in 1974 dollars to total $93.0 million.

Test 1a assumed a lower growth level for the corridor and no major freeway improvements, with buses operating in mixed traffic. With this alternative, freeway costs which might be incurred would be for new or improved interchanges and some selective widening of SR-4 for bus preferential treatment. These improvements have been estimated to total approximately $10 million.

Capital Costs: Capital cost estimates prepared for both bus alternatives assumed that BART would own the bus system and that BART or AC would operate the system. Capital costs included the following:

(1) Freeway improvements for automobiles and transit;
(2) Buses;
(3) Storage, maintenance and repair facility;
(4) Voice communication system;
(5) Service equipment, signs and shelters.

It also assumed that the cost of the last three items will not vary appreciably with each system. The total initial capital cost in 1974 dollars of Bus Alternative 1a is $14.6 million, compared to $98.9 million for Bus Alternative 1b. Bus Alternative 1b includes the total costs incurred in expanding SR-4. For 1b, the cost of exclusive busways was not broken out since the entire widening of SR-4 would represent a commitment to a regional allocation of funds to improve both bus and automobile travel in the Pittsburg-Antioch corridor. For the purposes of comparison with BART, the cost of replacing the entire bus fleet 2.5 times was added to the initial capital cost for Bus Alternative 1a and 1b; the average life of a BART car is 30 years compared to the 12 year average life of a bus. Adding these replacement costs for each alternative produces a total capital cost in 1974 dollars of $20.8 million (1a) and $73.1 million for 1b.

Operating Costs and Revenues: Based on schedules and the route network previously described, it has been estimated that it would cost $1.9 million per annum to operate Bus Alternative 1a and $2.9 million for 1b. Assuming a bus fare structure of 25 cents for limited trips, between 25-50 cents for basic trips and 50 cents for express trips, the annual revenue for Bus Alternative 1a (7,600 daily bus trips) would be $0.9 million and $1.4 million for 1b (11,700 daily bus trips). As a result, the annual operating deficit would be $1.0 million for Bus Alternative 1a and $1.5 million for Bus Alternative 1b compared to a net revenue of $2.3 million for BART.

1990 Bus-BART Comparison

Costs: For the purpose of comparison between the Bus Alternatives and BART, system capital and operating costs were taken into account. Capital costs were annualized assuming 40 year bonds at 7% interest. These costs were then added to annual operating revenues or deficits. The total of these annual costs is shown in Table 10-3. For a more realistic comparison between the Bus Alternatives and BART, costs per passenger trip were calculated accounting for the larger patronage volumes projected for BART. These costs, $1.20 (1a) and $1.61 (1b) and $1.34 for BART show that the cost per passenger trip for BART is 20 percent below the comparable cost per passenger trip for Bus Alternative 1b and 10 percent higher than 1a.

Travel Times: An examination of sample travel times from various downtown locations within the corridor to the Concord BART Station indicates that on an average, BART could perform the downtown trip in considerably less time than that required by either Bus Alternative (See Table 10-4).

For a person making a trip from a suburban location in Antioch or Pittsburg, bus would have the advantage of direct service assuming that patrons lived close to a bus line. However, BART patronage was estimated on the basis of feeder bus service to all stations and it has assumed that increased growth in and around corridor

Table 10-3. Bus-BART Capital and Operating Cost Comparison

			Capital Costs $'000's					Operating Costs $'000's			Capital and Operating Costs	
System	Operating Characteristics	Total Daily Trips (1)	Rolling Stock	Freeways & Structure	Systemwide Equipment	Rolling Stock (3) Replacement	Total Capital Cost	Operating Cost	Revenue	Total Net Revenue	(4) Cost/Year $'000's	Cost per Passenger Trip
Bus Alternative 1a	Bus in mixed traffic (No major improvement to SR-4)	7,600	42 buses $60,000 = $2,500	$10,000	$2,100	$6,250	$20,850	$1,900	$ 900	$1,000 (deficit)	$ 2,564	$1.20
Bus Alternative 1b	Bus in exclusive lane (SR-4 improve to 3-T-3 configuration)	11,700	62 buses $60,000 = $3,700	$93,000	$ 2,200	$9,250	$108,150	2,900	$1,400	$1,500 (deficit)	(5) $ 5,239	$1.61
BART	On-line Service (with bus feeder service)	36,000	$25,000	(6) $154,000	$32,000 (2)		$211,000	6,500	$8,800	$2,300	$13,527	$1.34

(1) Regional Transit Travel Projections Project for express bus trips.

(2) Includes electrification, train control, communications, yard and shops, parking facilities and fare collection.

(3) Refers to cost of replacing bus fleet 1.5 times to approximately 30 year life of BART car.

(4) Total capital costs were annualized over 40 years at 7% interest and annual capital cost was then combined with annual net revenue or deficit.

(5) For purposes of comparing costs per passenger trip, the cost of providing bus lanes for 1b was assumed to include 30.2 x 1.15 = $34.7 million from freeway and structure costs.

(6) Includes $7,000,000 for SR-4 freeway interchange additions and modifications

(7) All values are in 1974 dollars and do not reflect future inflation.

Table 10-4. BART/Express Bus Alternatives Travel Time Comparison

Trip	Mode	Travel Time
Oakley/Brentwood (1) to Concord BART	Bus Alternative 1a	71
	Bus Alternative 1b	61
	BART (plus 20 mins. on feeder bus)	38 mins.
Antioch to Concord BART (1)	Bus Alternative 1a	56
	Bus Alternative 1b	46
	BART	18 mins.
Pittsburg (2) to Concord BART	Bus Alternative 1a	26
	Bus Alternative 1b	22
	BART	13 mins.

(1) Trips originate downtown.

(2) Express bus trips originate at Pittsburg Freeway stop; BART originates in downtown Pittsburg.

communities would justify extensive route coverage. With the addition of a maximum 15-minute trip to an extension station, total trip times on BART and feeder buses would be less than for either bus alternative.

Convenience and Comfort - Bus versus BART: Experience has shown that public transportation ridership can be greatly increased by improving rider comfort, safety, ease and convenience of transfer, frequency of service and by reducing overall travel time. For example, opening of the BART TransBay Tube, providing direct connection between Concord and San Francisco resulted in a drastic reduction in Greyhound patronage in that corridor. The principal attraction of BART would be the 12-minute peak and 15-minute off-peak service which could not realistically be achieved with either Bus Alternative. For commuters, direct BART connection from Antioch and Pittsburg to other stations on the BART system would give BART a distinct advantage over the Bus Alternatives. Also, patrons either driving or riding feeder buses would take a maximum of 15 minutes to access any one of the four extension stations.

Express buses could not reach the high travel speeds, nor maintain the same average speeds as BART. On average an express bus trip from downtown Antioch to the Concord BART Station would take 25-35 minutes longer than the same trip on BART.

Apart from the BART/Bus maximum speed differential, buses would lose time, entering and leaving SR-4 at Antioch and Pittsburg, as well as on local streets and arterials in Concord. Improved travel time and one-stop convenience provided by BART could be offset by providing better bus coverage throughout the corridor. But this would be costly and would not prove realistic in view of lower population levels and more conventional spread growth problems assumed with the Bus Alternatives.

For persons living south of SR-4 and working in industrial locations to the north, the Bus Alternatives could have a distinct advantage although BART station feeder bus routes could be designed to cover most of these work locations. In the event of breakdowns, fewer people would be inconvenienced and delayed with the Bus Alternatives than with BART.

Environmental Impacts: The direct environmental impacts of the Bus Alternative la would not be as significant as the direct impacts of BART extension line and yard. However, where the Bus Alternative lb involves construction of additional freeway lanes and is associated with the secondary action of full freeway expansion, direct impacts would be greater than those experienced by BART. With the Bus Alternative lb, indirect impacts resulting from various levels of spread growth could be substantial when compared to the effects of concentrated growth patterns made possible by BART and related planning policies.

Community Impacts
Relocation: Relocation impacts associated with Bus Altern'ative la would be minimal. At least 200 housing units and five businesses and several community facilities would have to be acquired for Bus Alternative lb (implies SR-4 expansion): nearly four times as many houses and three times as many businesses as with BART.
Noise: An examination of noise generated by express buses operating during peak hour conditions on a relatively level portion of SR-4 between Antioch and West Pittsburg, indicates insignificant increases over projected 1990 ambient noise levels. With BART it is expected that ambient noise levels along SR-4 would fall between la and lb levels.

Although BART assumes more growth resulting in a higher number of average daily trips on SR-4 (65,000), more people would be coming into the corridor to work causing SR-4 directional flows to be balanced compared to predominantly out-commute flows predicted for la and lb; without freeway widening (la) traffic conditions would cause more accelerating and decelerating, and consequently higher noise levels. BART would place an additional noise source within the corridor, exposing more land uses to higher noise levels than either Bus Alternative, which limits noise increases to one transportation route. Also, with BART, ambient noise levels in and around downtown areas could be expected to increase as a result of new development, density increases and traffic accessing BART stations.
Visual Quality and Loss of Privacy: The visual character of the corridor will not be changed by Bus Alternative la. Additional freeway lanes, as proposed in Bus Alternative lb will have the effect of visually reinforcing the existing separation of communities north and south of SR-4.

With BART visual impacts will be greatest along Port Chicago Highway and in Pittsburg where a separation will be created between the old downtown area and the rest of the community. In Antioch, the BART station superstructure would block about 350 feet of view corridor out over the San Joaquin River It would however act as a viewing platform and an at-grade pedestrian overcrossing the railroad from downtown to proposed Marina activities. Approximately 300 houses and 35 businesses will be viewed directly from passing BART trains.

Local Government Costs: Bus Alternative la would have limited impact on local government costs when compared to Bus Alternative lb. Because more people would live in the corridor with Bus Alternative lb, and because growth would follow the 'trend' involving an extension of public service and utilities into difficult-to-serve areas, costs could be high. The cost of providing local bus service for either alternative would be borne by corridor communities which could apply for Transportation Development Act (TDA) and UMTA funds for part of the system capital and operating costs. The cost of local street improvements and beautification projects around BART stations would be moderate.

Natural Resource Impacts: The impact of Bus Alternative la will not be significant as this alternative assumes minimal improvements to SR-4. Expansion of SR-4 to accommodate exclusive bus and additional traffic lanes would create 155,480 lineal feet of new, and re inforce 2,912 lineal feet of existing impacts These impacts would affect critical wildlife habitats and plant communities, slope, seismic, fire and flood hazards, agricultural, water, visual and recreational resources. BART line and yard would create 65,000 lineal feet of new impacts and 91,400 lineal feet or reinforcing impacts.

Growth-Inducing Impacts: Growth inducing impacts associated with Bus Alternative la would be minimal because growth would take place in areas where development is already committed.

The combination of Bus Alternative lb and expansion of SR-4 would greatly improve mobility in and out of the corridor, facilitating corridor growth. Resultant growth patterns could closely approximate the "Trend Growth" future described in Section 3 of this report. Continuation of the trend will result in new growth into rural

Table 10-5. BART Noise Impacts (Along BART Line)

Activities	100' (78dba)	200' (74 dba)	300' (71 dba)	500' (68 dba)*
Houses	225 - 240	415 - 500	775 - 820	1450 - 1500
Apts.	14 - 20	50 - 60	90 - 115	
Schools	1			1
Parks	1			
Hospitals				1

* dba levels assume BART Aerial with sound barrier of BART production vehicles.

Source: Wilson Irhig and Associates, sound tests

Table 10-6. Bus Alternative Noise Impacts (Along SR-4)

Activities	100' (1a=76dba) (1b=77dba)	200' (1a=73dba) (1b=74dba)	300' (1a=70dba) (1b=71dba)	500' (1a=66dba) (1b=67dba)
Houses	195 - 205	470 - 485	800 - 820	1400 - 1450
Apts.	20	70	112	200 - 210
Schools	1		2	1
Parks				
Hospitals				1

(1) Numbers refer to average dba levels during the critical 10% of the day.

areas which may cause considerable and irreparable damage to the natural environment. These impacts could affect 4,650 acres of land with valuable biological resources, agricultural and water resources, or visual and recreational resources. In addition, impacts affecting about the same number of acres of hazard areas subject to slope failure, high seismic response, fire and flooding will jeopardize this new growth. Many of the impact areas overlap. If, with the BART Alternative, growth controls are adhered to, growth inducing impacts would be relatively minimal and would not have measured environmental impacts in present rural areas.

Air Quality and Energy Requirements: Energy requirements and air quality are considered together because they will both depend on future levels of growth, land use, and mode mixes. Together, air quality impacts and energy demands can be considered internally (corridor) and externally (region). Although as yet no model has been developed which could provide an assessment of the regional air quality and energy impacts of an Extension versus a Non-Extension, a number of generalizations can be made:

1) With limited growth, increases in energy consumption and air pollutants would be moderate. If pollutant emissions are reduced 50% by 1990, traffic volume increases would generate little or no increase in air pollutants.
2) If trends continue and corridor population reaches 350,000, more people will be commuting to dispersed job locations outside the corridor. In this event, buses would have to compete with the convenience of the private automobile facilitated by a much improved road network. Many more short home-based non-work trips would be made resulting in more "cold starts" which consume high amounts of energy and create more pollution.
3) Although more growth will occur with BART, more opportunities would exist for living closer to transit and employment destinations within walking or shuttle bus distance of a BART station.
4) With BART, the number of home-based non-work trips may be less and average trip distances would be shorter because of the emphasis on clustered development patterns which in turn would make walking and bicycling more attractive for short trips. As a result, energy consumption and air pollutant levels could be significantly below "trend" levels.
5) If growth does not occur in the Pittsburg-Antioch corridor (hindered by No-BART), it is assumed that growth which would otherwise be assigned to the corridor would be absorbed in other parts of the Bay Region. In this event, changes in air quality levels and energy consumption increases would vary with the location and nature of that growth. If growth is allowed to occur in areas poorly served by transit or in a manner which would preclude adequate service by transit, the regional impacts on air quality would be noise and energy consumption higher than those impacts expected with the BART extension.

For persons living south of SR-4 and working in industrial locati

Although BART assumes more

when compared to Bus Alternati

Section 11: Next Steps

This report marks the conclusion of preliminary planning for the Pittsburg-Antioch BART Extension Project. The next phase of the project will be equally as important as the planning phase. It will answer the question as to whether BART shall be extended, and if it is, "When and How" the extension will be constructed. These tasks require continued participation by city officials, community groups, and residents of the corridor to be meaningful and successful. In addition, BART and MTC's responsibilities will intensify as the lead administrative agencies in the implementation process.

PROJECT REVIEW

The implementation of any transit improvement in this region will depend, partially, on the level of public support it inspires. This support will be viewed by MTC as an indication of the extent of the transportation problem and of the public's faith in the proposed improvement as the appropriate solution. MTC, as the regional transit planning and coordinating agency, has the responsibility for determining which proposed projects represent the most critical regional transportation needs. By assigning each project a level of priority, MTC is able to match regional needs to available funding sources and determine its annual funding allocations. A Pittsburg-Antioch BART extension raises many issues concerning the rate and character of growth which could take place in the corridor area. During the review period which follows distribution of the Final Draft Report and Popular Summary Report corridor cities, agencies, citizens and interest groups will be able to decide what kind of growth future they want. However, for the purpose of the following section, it will be assumed that there will eventually be both citizen and governmental endorsement of the extension.

PROJECT APPROVAL

Upon completion of the local review process, a fully documented Draft Final Report will be submitted to the Urban Mass Transportation Administration (UMTA). Following their review and anticipated acceptance, a Final Report will be published. It is at this time that the BART staff will present the findings and conclusions of the study to the BART Board of Directors and recommend that this body approve and adopt in principle the suggested extension route and its integrated development package. The Board of Directors can then make a recommendation to the Metropolitan Transportation Commission that the recommended BART extension can be incorporated into the Regional Transportation Plan and be considered as a high priority among the region's transportation improvement needs.

PROJECT ADVOCACY AND THE REGIONAL PLAN

In order to keep the implementation process proceeding at a meaningful rate, it is incumbent upon the BART Board of Directors and each municipality in the corridor through its officials and staffs to adopt a strong advocacy position for the PAX extension.

Community organizations, civic and special interest groups throughout the corridor should be continually made aware of the significance of this project and encouraged to join the ongoing efforts of the PAX Citizens Advisory Group in support of the extension.

PRE-CONSTRUCTION LAND USE PLANNING

This study has used a comprehensive planning approach in arriving at a final transit extension route. This approach has considered the social, environmental and political implications of each extension alternative, as well as its economic and physical impacts.

The study team has worked closely with city planning and public works officials to arrive at an extension proposal which takes advantage of all opportunities to maximize ridership and to use transit as a positive tool in the urban and regional development process.

As an integral part of this implementation scheme, it is important that the cities of Concord, Pittsburg, and Antioch and Contra Costa County begin now to consider the recommendations of this study in its planning and decision making. Some actions which these municipalities may take to insure the preservation of the transit and urban development goals that this extension is designed to meet include:

(1) Officially adopt the recommended route into the city and county's comprehensive plan.

(2) Encourage development around station sites which will allow maximum utilization of the public investment which the station represents, and encourage rather than deter maximum levels of ridership.

(3) Make zoning and other land-use decisions which are compatible with this concept.

(4) Preserve right-of-ways needed to construct the BART extension to prevent excessive costs at the time of construction.

(5) Solicit financial assistance now (state and federal) to assure timely implementation of desired redevelopment activities.

(6) Develop programs which will minimize the social and economic impacts of the extension on existing communities.

This early planning approach will not only assure desirable land use and development patterns which will be compatible with the extension at the time it is ready for service, but will serve as further testimony of the local governments commitment to transit as the desired solution to the regional transportation needs. This process should also include endorsement of the BART express bus system to encourage residents to become aware of the benefits of public transportation.

PROJECT MONITORING AND COMMUNITY INVOLVEMENT

Every effort should be made by the cities to include area residents in planning and land-use decisions that will affect the future extension. The Citizens Advisory Committee is encouraged to develop a strong civic involvement in these matters to insure that their inputs and the interests of this project are considered.

In addition to its involvement in civic matters, the CAC should establish direct contact with their MTC Commissioner. A close liaison with this body will insure ongoing and responsible community input about this project, and increase citizen awareness of other regional transportation decisions.

PROJECT FUNDING

As was stated in Section 9, the source of project funding is critical to the success of making the extension a reality. Those agencies and individuals involved in the project must be constantly aware of the potential funding sources and must be ready to move the extension into final design when acceptable financing becomes available.

FINAL DESIGN AND CONSTRUCTION

Either prior to or during the final design stage, certain decisions will have to be made to resolve those issues which can not be settled at this stage of analysis:

(1) If the Navy abandons its Weapons Station in the Port Chicago area before final design commences, a decision must be made whether to alter the recommended alignment and extend the route through this area to take advantage of new residential and industrial development in the vicinity of Port Chicago. A result of this decision will involve the location of a station in the area, and the possible elimination of either the proposed North Concord or West Pittsburg Station or both.

(2) The West Pittsburg Station has been located based on strong interest by potential developers to create both retail shopping and residential development on the selected site. The ideal situation would completely integrate the BART station into the development. Therefore, BART's future incorporation must be provided for as developers plans firm up.

(3) This report proposes an aerial structure through Pittsburg. The City has indicated that only a subsurface line through the City would be allowed. This issue must be resolved and equitable funding arranged between the District and the City of Pittsburg if it is decided to construct a subway line.

(4) A waterfront location is recommended for the station in Antioch. Antioch has expressed an interest in locating the line and station on an aerial structure along Fourth Street. The merits and demerits of these alternatives will also require more thorough analysis.

With these issues resolved, a detailed design of line and stations can proceed. The design will be based on the recommendations contained in this preliminary planning report. It is anticipated that the design and construction of the PAX extension will require between 6 and 8 years to complete, from the time that acceptable financing is secured.

For persons living south of SR-4

Appendix

References

Although BART assumes more

when compared to

TECHNICAL ADVISORY COMMITTEE

J.P. McBrien, County Administrator
Contra Costa County

J. Connery
Local Area Formation Commission
Contra Costa County

F. Stewart, City Manager
City of Concord

W. Russell
California Department of Transportation

E. Phillips
City of Concord

T.A. Wood
U.S. Naval Weapons Station

R. Pence
California Department of Transportation

P. Archuleta, Planning Director
City of Antioch

G. Cherrier

B. Strain

L. Walton, City Administrator
City of Martinez

S.A. Donato, City Manager
City of Pittsburg

T. Oglesby, City Manager
City of Antioch

G. Poertner, City Administrator
City of Brentwood

M.E. Ohman, City Administrator
City of Clayton

D. Smith
City of Walnut Creek

P. Bay
Metropolitan Transportation Commission

S. Super
Metropolitan Transportation Commission

T.R. Lammers
California Department of Transportation

B. Nelson, Planning Director
Solano County

H. Hornbeck
East Bay Regional Park District

J. Holmes
Southern Pacific Transportation Company

R. Jones
Atchison Topeka, and Santa Fe

J. Miller
Western Pacific Railroad

P. Kilkenny, Assistant Director
Contra Costa County

J. Cutler
Contra Costa County

A. Dehaesus, Planning Director
Contra Costa County

N. Bevilacqua
City of Pittsburg

C. Zahn
Contra Costa County

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Manager, Chamber of Commerce
F. Quesada
W. Redic
F. Saragosa
A. Seeno
E. Smith

Other Areas

C. Bell
Walnut Creek, California

E. Cinquini
Brentwood, California

G. Doneux
Brentwood, California

D. Hanner
Brentwood, California

K. Johnson
Clayton, California

B. Polsley
Danville, California

CONSULTANT STEERING COMMITTEE

PBQ&D, Inc.
J.E. Everson
P.H. Gilbert, Alternate

Tudor Engineering
L.W. Riggs
S.H. Froid, Alternate

Bechtel Corporation
J.P. Buehler
J.G. Dillon, Alternate

Wilbur Smith & Associates, Inc.
R.C. Brown, Jr.
W.C. Sylvan, Alternate

References

This section contains text footnotes and a bibliography of reference material which has been used in the PAX study.

The bibliography has been divided into six basic reference sections: plans/policies, land use regulation, public works, environmental information, base data, and computer tapes.

FOOTNOTES

1. Aerial Structure Sound Barrier Wilson, Ihrig and Associates, Inc., September, 1970.
2. Contra Costa County Open Space and Conservation Element Contra Costa County Planning Department, April, 1973.
3. Report on the Conversion of the Concord Naval Weapons Station - Citizens Committee for the Weapons Station Conversion, September, 1974.
4. Concord Major Street and Highway Study, Wilbur Smith & Associates, August, 1967.
5. Lampman and Associates, Antioch General Plan Program, Opinion Survey, City of Antioch, Lampman and Associates, January, 1973.
6. Antioch General Plan Program, Circulation Element, Lampman and Associates, July, 1974.

BIBLIOGRAPHY

I. Plans/Policies

Association of Bay Area Governments

ABAG Regional Plan 1970-1990, Association of Bay Area Governments, July 1970.

Metropolitan Transportation Commission

Regional Transportation Plan (Proposed), MTC, July 1973.

Contra Costa County

City Spheres of Influence (Memorandum) Contra Costa County Local Agency Formation Commission, December 1972.

Contra Costa County Open Space and Conservation Element (Draft, now adopted in modified form), Contra Costa County Planning Department, April 1973.

Contra Costa County Transportation Needs Study, Preliminary Report, DeLeuw Cather & Company, 1972.

Discovery Bay, Environmental Impact Report and Plan, Contra Costa County, 1972.

LUTS City-County Goals, Contra Costa County Planning Department, March 1970.

LUTS Preliminary Housing Element, Contra Costa County Planning Department, April 1970.

Parks & Recreation Plan, Contra Costa County, Contra Costa County Planning Department, December 1970.

Preservation/Prime Agricultural Lands in Eastern Contra Costa County, Contra Costa County Planning Department, January 1972.

Antioch

Antioch, Master Land Use Plan, City of Antioch, Hahn, Wise and Associates, April 1956.

Antioch General Plan Program, Geological and Seismic Safety Element, City of Antioch, Lampman and Associates and F. Beach Leighton and Associates, March 1973.

Brentwood

Brentwood: Future Growth and Development, Memorandum, Duncan & Jones, September 1971.

Brentwood General Plan, City of Brentwood, Warren W. Jones and Associates, November 1965.

Downtown Area General Plan - Brentwood, Duncan & Jones, December 1968.

Policies for Land Development, Subdivision and Urban Expansion in Brentwood Planning Area, Duncan & Jones, January 1969.

Concord/Clayton

Central Area Plan, City of Concord, City of Concord, December 1971.

City of Concord, Conservation Element, City of Concord, 1973.

City of Concord General Plan, City of Concord, August 1971.

Concord 70 - A proposal for unifying Concord's growth (Stanford University), June 1968.

Clayton General Plan (Map included 1" = 1600'), City of Clayton, Wilbur Smith & Associates, August 1971.

City of Concord Trails Plan, City of Concord, February 1972.

Report on the Conversion of the Concord Naval Weapons Station Contra Costa County, California, Citizens Committee for the Weapons Station Conversion, September, 1974.

Concord Major Street and Highway Study, Wilbur Smith & Associates, August, 1967.

Pittsburg

Community Goals Document, City of Pittsburg, December 1972.

Pittsburg Model Cities - 1st and 2nd Year Action, Progress Reports and Evaluations, Model Cities Agency, 1972.

Pittsburg Model Cities - 2nd Year Demonstration Plan, Model Cities Agency, September 1972.

Pittsburg Waterfront Study Work Stage One - Paul Fullerton and Environmental Planning and Research, Inc., September, 1972.

"Pittsburg Marina Expansion," City of Pittsburg, California, Environmental Impact Report, prepared by Community Development Department, Rough Draft, March, 1974.

Redevelopment Plan for Marina View Project, City of Pittsburg, January 1968.

Redevelopment Plan for Riverside Mall Project, City of Pittsburg, January 1970.

Martinez

Martinez General Plan, 1980, City of Martinez, 1964.

Open Space Conservation, Seismic Safety, Scenic Roadways, General Plan Elements, Martinez, City of Martinez, Sedway/Cooke, July 1972.

Clayton General Plan, Basic Research Report, (Map 1" = 1600'), City of Clayton, Wilbur Smith & Associates, February 1970.

Concord Retail and Office Floor Space Data (Tabulation of size, use and address by parcel), Contra Costa County Planning Department, 1970.

Future Population Study (Technical Materials), City of Antioch, April 1972.

Housing Costs and Characteristics (Tables) PAX Study Area, 1970 updated to 1973, source: 1960 and 1970 Census, N. Cal. Real Estate Research Committee.

Antioch General Plan Program, Demographic and Economic Characteristics, City of Antioch, Lampman and Associates, March 1973.

Housing Needs of the Needy (Tables) Association of Bay Area Governments, January 1973.

Industrial Firms (address, activity, number of employees) PAX Study Area, 1972, City Chambers of Commerce.

Land Ownership, Map-parcel size and ownership (1" = 2000' scale), 1972, Contra Costa County Assessors rolls.

Area Measurements: Major Economic Areas, LUTS Statistical Areas, 1970 Census Tracts and LUTS Traffic Zones (Technical Memorandum), Contra Costa County Planning Department, July 1970.

LUTS Department of Traffic Analysis Zone, (Technical Report), Contra Costa County Planning Department, July 1970.

LUTS Employment Inventory: Methods, Procedures and Products, (Technical Memorandum), Contra Costa County Planning Department, August 1971.

LUTS Inventory for the Conservation Element (Report contains small scale maps of physiographic regions, topography and hydrology, slope, geology, soils, vegetation and rainfall), Contra Costa County Planning Department, August 1971.

LUTS Transit Inventory Manual, (Discusses data requirements and sources and inventory procedures), Contra Costa County, April 1971.

Land Use (1970) (Colored non-reproducible map 1" = 2000' scale PAX Study Area, excluding Concord), Contra Costa Planning Department.

Land Values, Mapped per-acre values for undeveloped or underdeveloped parcels corridor at 1" = 2000' scale, 1972-1973, Assessors rolls, real estate, firms.

City of Pittsburg General Plan, Research Report, City of Pittsburg, Hahn, Wise and Associates, 1972.

Residential growth 1970-1973 proposed land use intensities, probable holding capacities, (Map 1" = 600' and tables), Concord Planning Department, 1973.

Retail Sales, Contra Costa County and Cities (Tables), State Board of Equalization, 1970-1972.

Subdivision Trends 1955-1972, (non-reproducible overlays of 5 year increments. Color coded 1" = 400' scale), Contra Costa County.

VI. Computer Tapes

This data has been coded according to the grid coordinate system being used by the Contra Costa County Land Use and Transportation Study and is stored on computer tape. It was used by PAX to develop composite mapping for the environmental impact and development/redevelopment evaluations in the study:

A. MAPS: Maps have been coded for the PAX study area from USGS 1" = 2000' scale base mapping, according to a grid coordinate system used by LUTS and based on the California State Plane system. Cells are 6.12 acres in area. These maps can be printed out at 1" = 2000' or 1" = 4000' with symbols or density gradations achieved by over-printing.

Zones (see B)
- LUTS Traffic Zones
- 1970 U.S. Census Tracts
- MTC 440 Zones (for RTTPP Task III testing)

Land Use
- 1970 Land Use
- Land Ownership Characteristics
- Land Value
- Urban Utilities
- Zoning (existing)

Land Resources
- Surficial Deposits
- Soils Series
- Elevation
- Slope
- Slope Aspect
- Vegetation
- Drainage Areas
- Watersheds
- Geology
- Faults
- Flood Areas
- Soils Characteristics Maps: Effective Depth, Available Water Capacity, Drainage, Alkalinity/Salinity, Sub-surface Soil Permeability, Land Capability Unit, Hydrological Soils Group, Soil Erosion Hazard, Shrink Swell, Soil Pressure, Water Table, Slippage Fire Hazard, Wind Erosion, Subsidence
- Geology Characteristics: Age Rank, General Lithology, Approximate Landslide Coverage, Probable Seismic Response.

B. 1970 U.S. Census Summary Tapes, 29 Tabs, 793 data items (can be mapped by 1970 census tracts coded for Study Area - see A.)

C. Employment by 2 digit S.I.C. classification (can be mapped by 1970 Census Tracts except where suppressed) Source: Contra Costa County, compiled from Department of Human Resources and State Board of Equalization records. Supplemented by employee survey.

II. Land Use Regulation

Proposed City Spheres of Influence, (non-reproducible print: 1" = 400' scale), Local Agency Formation Commission, October 1972.

Zoning Maps, Contra Costa County, Concord, Pittsburg, Brentwood, Antioch, Martinez, (Prints, overlay for Concord), Contra Costa County and Cities.

Zoning and Subdivision ordinances, City of Concord, ABAG Summary Report: Regional Open Space Plan, Phase II, Association of Bay Area Governments, April 1972.

Zoning and Subdivision Ordinances, Contra Costa County, County and City.

III. Public Works

Alternatives for Evaluation, Sacramento-Stockton-San Francisco Bay Area Corridor Study, prepared for the California Business and Transportation Agency, July 1973.

Contra Costa Water Quality Study, Contra Costa County, Brown and Caldwell, 1972.

Functional Road Classification, 1990 (non-reproducible maps: 1" = 2000' scale), Division of Highways, February 1972.

Power Transmission, Gas and Oil Lines, Contra Costa County, (non-reproducible print and overlay 1" = 400' County), Contra Costa County, April 13, 1973.

Railroad plans and policies (Southern Pacific, AT&SF, SNRR), (Maps, memos and interviews) October 1972 - April 1972.

Refuse Disposal Plan (Preliminary Report), Contra Costa County, 1972.

School, Water and Sanitary Districts, Contra Costa County, (non-reproducible prints: 1" = 4000' County), Contra Costa County, 1972.

Sewer Lines, Contra Costa County, (non-reproducible map 1" = 4000' scale), Contra Costa County, April 13, 1973.

Water Lines, Contra Costa County, (non-reproducible print: 1" = 4000' scale), Contra Costa County.

IV. Environmental Information

A. Critical Hydrological Characteristics (flood plains, diked and submergible lands, submergible lands, subsurface aquifers)

Potential Interpretations: water resource potential, water quality conditions, development constraints

1) Contra Costa County "Topography - Hydrology Map", from LUTS Inventory for the Conservation Element, August, 1971
- map scale: 1" = 400'
- coverage: county

2) Corps of Engineers, Flood Insurance Studies (see #14)
Note: some studies have been completed for various parts of the County.

3) Tuttle, Donald C. (1967) Hydrological Development of the Walnut Creek Watershed
- availability: U.C. Berkeley, Water Resource Library G4482 J7

4) USGS - Ground water data as of 1967, N. Coastal, S.F. Bay, Central Coastal, Sacramento Basin
-- by J.S. Bader, 1969
- availability - U.C. Berkeley, Water Resources Library G409133 J9

5) East Contra Costa Irrigation District, Ground Water Survey; lines of equal difference 1937
- map scale: 1:12,000 or 1" = 1000'

6) Metcalf & Eddy, Engineers (1965), An Economic Evaluation of the Water Quality Aspects of Contra Costa County's Offshore Water Supply, Palo Alto (available from Water Resource Library G4487 J5-1)

7) Leeds, Hill and Jewett, Inc. (1971), Proposed project plan for Contra Costa Water Supply System, submitted to Contra Costa Water District, San Francisco (available W.R. Library G448 K1)

8) Bechtel Corporation (1969), Feasibility Investigation of Water Renovation in Central Contra Costa County, Bechtel Corp., San Francisco, (available from Water Resources Library, G4487 J9-1)

9) McClelland, E.J. (1965), Aquifer-test compilation for Northern California, U.S.G.S. (prepared in cooperation with the California Dept. of Water Resources, Sacramento) (available from Water Resources Library G420 J5-4)

10) Contra Costa County Water District (1969), The Delta, Source of Supply for Contra Costa County Water District (before the State Water Resources Control Board, State of California) (available from Water Resources Library G4485 J9)

11) Kunkel, Fred (1970), Summary of Ground-water Occurrence in California, USGS Water Resources Division, Menlo Park (available from Water Resources Library G40913 K)

12) USGS & California Department of Water Resources - Mineral and Water Resources of California, Part II Water Resources, 1966

13) U.S. Army Engineers, Survey Report for Flood Control on Walnut Creek Basin California, Sac: Corps of Engineers, Sacramento District, April 1958

14) U.S. Army Corps of Engineers, Flood Plain Management Section, Sacramento District - Flood Insurance Studies have been completed for Pleasant Hill, Concord, and Walnut Creek. Flood hazard evaluations have been completed for parts of Antioch and Brentwood. A Delta flooding study has also been completed. These reports can be reviewed in the Sacramento Office - 650 Capital Mall, Federal Courts Bldg. Room 5056, Rex Bronson (916) 449-3550.

B. Plant Communities

Potential Interpretations: plant succession, plant community tolerances to development, critical wildlife habitats.

Sources

1) Blaney, Harry F. (1963), Evapotranspiration-Climate Comparisons in Coastal Fogbelt, Coastal Valley, and Interior Valley Locations in California; discussion (available Water Resources Library, Blaney 44)

2) NASA Infra-red Space Photography - contact Tom Pochari, NASA Ames Research Center, Sunnyvale concerning availability of photos for study areas.

C. Precipitation

Potential Interpretations: Slope stability, erosion hazard, plant succession.

Sources:

1) USGS, Precipitation Depth - Duration - Frequency Relations for the San Francisco Bay Region, California, by S.E. Rantz, 1971 (Basic Data 25)
- map scale: 1" = 8 miles
- coverage: Bay Region

2) USGS, Mean Annual Precipitation and Precipitation Depth - Duration - Frequency Data for the San Francisco Bay Region, by S.E. Rantz, 1971 (Basic Data 32)

3) USGS - Suggested Criteria for Hydrologic Design of Storm-Drainage Facilities in the San Francisco Bay Region, California by S.E. Rantz, 1971 (Basic Data 3)

4) Contra Costa County, "Average Annual Rainfall Map", from LUTS, Inventory for the Conservation Element, August, 1971
- map scale: 1" = 4000'
- coverage: Contra Costa County

D. Mineral Resources and Fossil Fuel Deposits

Sources

1) Division of Mines, Department of Natural Resources, Geologic Map of Contra Costa County, showing Mines, Quarries, and Gas Wells (Journal, Vol. 54, No. 4, Plate 5)

2) Division of Mines (Special Report # 80) Geology and Mineral Resources of Mt. Diablo, Contra Costa County, California, by Earl H. Pampeyab, 1964

E. Miscellaneous Sources Pertaining to PAX Issues

Air Pollution

1) Decker, Fred W., Air Pollution in the Pacific Northwest and a Meteorological Cure, A paper presented at the AMS annual meeting, San Francisco, February 1, 1968

2) Weedfall, Robert O., and Linsky, Benjamin, A Mesoclimatological Classification System for Air Pollution Engineers, A paper presented at the 61st annual meeting, Air Pollution Control Association, St. Paul Hilton Hotel, St. Paul, Minnesota 55101, June 23-27, 1968

3) Middleton, J.T. California Against Air Pollution, California Department of Public Health, Sacramento, 1961.

4) Leighton, Philip A.,

"Geographical Aspects of Air Pollution", in Man's Impact on the Environment ed. by Thomas R. Detwyler 1971 (McGraw-Hill)

5) Bay Area Air Pollution Control District, A Study of Air Flow Patterns in the San Francisco Bay Area, by C.L. Smalley, Technical Services Division Information Bulletin, San Francisco: June 1970

6) Association of Bay Area Governments, Aviation Effects on Air Quality in the Bay Region (February 1971)

7) Bay Area Air Pollution Control District, - "Oxident Experience and Geographic Distribution in the San Francisco Bay Area," Technical Services Division Information Bulletin 5-69, 1968

F. Water Quality

1) California State Department of Water Resources. Delta Water Requirements. appendix to Bulletin No. 76, Delta Water Facilities, February, 1962

2) Weibel, S.R., Anderson, R.J. and Woodward, R.L. Urban Land Runoff as a Factor in Stream Pollution, Jour. Wat. Poll. Cont. Fed., 36, July 1964.

3) AVCO Economic Systems Corporation. Storm Water Pollution from Urban Land Activity, prepared for the Fed. Wat. Quality Admin., Department of the Interior, Program No. 11034 FKL, July 1964.

4) "North San Francisco Bay Water Quality" in Contra Costa Water Quality Study by Brown and Caldwell (Chapter 5 of report) 1972

G. Recreation & Open Space Values

1) Altorney, E.G., Crampon, L.J. and Willeke, G.E. Recreation and Fishery Values in the San Francisco Bay and Delta, Stanford Research Institute, October 1966.

2) "Contra Costa County Land Uses," in Contra Costa Water Quality Study by Brown and Caldwell (Pages 54 to 58 define agricultural, recreational, and other land uses in Contra Costa County).

3) Contra Costa County Planning Department Inventory of Historical Sites, Contra Costa County, draft for use in preparation of County's conservation element, 1972

4) Association of Bay Area Governments, Major Park, Recreation, Socio-cultural Facilities and Historic Features of the San Francisco Bay Region, 1972
- map scale: 1: 250,000
- coverage: Bay Region - only city parks larger than 100 acres have been shown.

5) Overview, "Proposed Regional Parks in East Bay - Regional Park District," - map by Overview identifying proposals described during public hearings associated with current EBRPD Recreational Open Space Study, 1972
- map scale 1: 24,000
- coverage: Contra Costa & Alameda Counties

H. Wildlife Values and Habitat Types

Potential Interpretations: Critical habitat requirements for mammal, waterfowl, aquatic and upland fowl species; habitat association and migration routes.

Sources:

1) (1969) Must destructive degradation come to the waters of the Delta and San Francisco Bay? A report on the impending threats to the existing beneficial environment of the West Coast's greatest estuary. (C.C. Co. Board of Supervisors) (available from Water Resources Library, J9-2).

2) Tarp, Fred H. (1967), Ecological Effects of Federal-State Water Planning on the Delta Fisheries, Report to the Contra Costa County Board of Supervisors, Ex-Officio Governing Board, Contra Costa County Water District (available from Water Resources Library, G432, J7-3)

3) California Department of Fish and Game, Fish and Wildlife Resources of San Francisco Bay and Delta: Description, Environmental Requirements, Problems, Opportunities and the Future. Task VII-1b, prepared for the San Francisco Bay - Delta Program, June 1968.

4) USGS - Water Temperatures of California Streams by J.C. Blodgett, 1971 (Basic Data Contribution #24)

5) Division of Mines and Geology "San Francisco Bay Tidelands," by Raymond Pestrony, 1972 (California Geology Vol. 25, No. 2)

6) S.F. BCDC. Some Ecological Aspects of San Francisco Bay by H. Thomas Harvey, San Francisco: 1966.

I. Miscellaneous Sources

1) "Environmental Characteristics of Contra Costa County" from Contra Costa Water Quality Study by Brown and Caldwell, 1972

2) Contra Costa County, Land Use and Transportation Study - Inventory for the Conservation Element, 1971

3) Contra Costa County - "Draft of Background data for use in County's Conservation and Open Space Element," prepared by John Gilcrest, 1972

J. Surficial Geological Formations

Potential Interpretations: Slope stability, potential seismic response, building and service facility construction cost implications, mineral resource location.

Sources:

1)USGS - Preliminary Photointerpretation Map of Landslide and Other Surficial Deposits of Parts of the Pittsburg and Rio Vista 15-minute Quadrangles, Contra Costa and Solano Counties, California by John D. Sims and Tor H. Nilsen, 1972 (Basic Data Contribution 35)
- map scale: 1: 62,500 (1: 24,000 available)
- coverage: Honker Bay, Antioch North, Jersey Island and Bouldin Island Quads

2) USGS - Preliminary Photointerpretation Map of Landslide and other Surficial Deposits of the Mount Diablo Area, Contra Costa and Alameda Counties, California by Tor H. Nilsen, 1971 (Basic Data Contribution 31)
- map scale: 1: 62,500 (1: 24,000 available)
- coverage: includes Clayton and Antioch South Quadrangles

3) USGS - Preliminary Photointerpretation Map of Landslide and other Surficial Deposits of the Byron Area, Contra Costa and Alameda Counties, California by Tor H. Nilsen, 1972 (Basic Data Contribution #38)
- map scale: 1: 62,500 (1: 24,000 available)
- coverage: includes Brentwood Quadrangle

4) USGS - Map Showing Distribution and Cost by Counties of Structurally Damaging Landslides in the San Francisco Bay Region, California, Winter of 1968-69 by Fred A. Taylor and Earl E. Brabb, 1972 (Basic Data Contribution 37)
- map scale: 1: 500,000
- coverage: Bay Region

5) USGS - Estimated Relative Abundance of Landslides in the San Francisco Bay Region, California by Dorothy H. Radbruch and Carl M. Wentworth, 1971 (Basic Data Contribution 11)
- map scale: 1: 500,000
- coverage: Bay Region

6) USGS - Preliminary Map of Historic Margins of Marshland, San Francisco Bay, California by Donald Nichols and Nancy A. Wright, 1971 (Basic Data Contribution 9)
- map scale: 1: 125,000
- coverage: Bay Region

7) Stanford University, An Analysis of Selected Landslides in Alameda and Contra Costa Counties, California by J.P. Waltz 1967 (Stanford PhD - University Microfilms, Ann Arbor, Michigan)
- map scale: ?
- coverage: ?

8) University of California, Berkeley, Earthquake Engineering Research Center. A Simplified Procedure for Evaluating Soil Liquefication Potential, by H.B. Seed and I.M. Idriss 1970 (Report No. 70)

9) Prentice-Hall publication, "Surface Faulting and Related Effects" in Earthquake Engineering by M.G. Bonilla (Editor R.L. Wiegal)

10) Division of Mines, Map Sheet Series, Geology and Slope Stability of the Southwest Quarter of the Walnut Creek 7.5 Quad., Contra Costa County, by Richard B. Saul
- map scale: 1: 24,000
- coverage: SW quarter of Walnut Creek Quad (study is outside of our immediate area of concern)

11) Contra Costa County Building Inspection Department, Unpublished Files of the County Grading Engineer Concerning Landslides, Drainage, and Grading Problems in Contra Costa County 1958 - present.

12) USGS - Preliminary Report on Landslides in a Part of the Orinda Formation, Contra Costa County, Calif., Unpublished Open File Report by D.H. Radbruch and L.M. Weiler, Menlo Park, 1963.

K. Soil Types

Potential Interpretations: Agricultural capability, erosion hazard, surface permeability, subsurface permeability, shrink-swell, water holding capacity, bearing capacity, slope stability.

Sources:

1) USDA Soil Conservation Service, Soil Survey Photo Field Sheets for Contra Costa County

2) USDA Soil Conservation Service, CF77 and CF186A Index of Soil Mapping Units and Interpretative Groupings (for soils in Contra Costa County)

3) Contra Costa County, "Soils", a section from Contra Costa County's Conservation and Open Space Plan draft of background resource information, 1972.

4) Welch, L.E. (1968) Contra Costa County General Soil Survey and Report, Contra Costa Soil Conservation District (available from Water Resources Library, G448 J6-2 1968)

5) Carpenter, E.J. and S.W. Cosby (1939), Soil Survey of Contra Costa County, U.S. Department of Agriculture, Series 1933, No. 26, U.S. Bureau of Chemistry and Soils, in cooperation with the University of California, Ag. Exp. Sta. (available from Water Resources Library, G-4056 CON 1939).

6) Calif. Division of Soil Conservation, A Preliminary Investigation to Determine the Feasibility of the Installation of Works of Improvement within Mt. Diablo-Seal Creek Watershed, Contra Costa County, California, Sacramento, November 1967.

L. Salt Water Intrusion

1) Tolman, C.F. Hyde, B.C., and Killingsworth (1931) Ground Water Supply and Saline Contamination of Pittsburg and adjacent industrial area, Contra Costa County, Stanford University Department of Geology (Palo Alto) (available from Water Resource Library, F1)

2) Kempkey, Augustus (1938), Salinity Graphs Antioch and Pittsburg (available from Water Resources Library, G4202, F8)

3) Owen Langdon W. (1964), Salinity Intrusion and Related Studies, Sacramento-San Joaquin Delta, (presented before a specialty conference, El Paso, Texas) (available from Water Resources Library G432, J4-4)

4) Senate Select Committee on Salinity Intrusion in Agriculture Soils (1970), Intrusion of Ocean Salinity, S.F. Bay and Sacramento-San Joaquin Delta, A bibliography and summary (available from Water Resources Library G4203, K).

5) Calif. Dept. of Water Resources, Salinity Incursion and Water Resources, Appendix to Bulletin No. 76, Delta Water Facilities, Sacramento: Calif. State Office of Printing, April 1962.

M. Geological Formations, Including Fault Lines

Potential Interpretations: Ground water recharge area, excavatability, slope stability, settlement zones, seismic response, sedimentation, fault activity.

Sources:

1) USGS - Preliminary Geologic Map of the Mt. Diablo-Byron area, Contra Costa, Alameda, and San Joaquin Counties, California, compiled by Earl Brabb, Howard Sonneman and John R. Switzer, Jr., 1971 (Basic Data Contribution #28)
- map scale: 1: 62,500 (1: 24,000 may be available)
- coverage: Clayton, Antioch South, and Brentwood Quads (only 1/2 of study area)

2) USGS - Faults that are historically active or that show evidence of Geologically young surface displacement, San Francisco Bay Region, A progress report: October, 1970, by Robert D. Brown, Jr. (Basic Data Contribution 7)
- map scale: 1: 250,000
- coverage: entire study area

3) USGS - Areal and Engineering Geology of the Oakland East Quadrangle, California by Dorothy H. Radbruch, 1969.

4) USGS - Generalized Geologic Map of the San Francisco Bay Region, by J. Schlocker (Basic Data Contribution #8)
- map scale: 1: 500,000
- coverage: entire county

5) Diablo Valley College, Surface Geology of Contra Costa County, by Don L. Protzman, 1964.
- map scale: 1: 133,056 (1" = 2.1 miles)
- coverage: entire county

6) University of Washington Publications, Eocene and Paleocene Deposits at Martinez, California by C.E. Weaver, 1953.

7) Geological Science Bulletin, California University Publications, Vol. 28, No. 13, pp. 367-406, The Sobrante Sandstone by G. Lutz, 1951.
- map scale: 1: 30,000

8) University of California, Berkeley, Geology of the Sobrante Anticline and Vicinity, Briones Quadrangle, Contra Costa County, California, by M.H. Pease, Jr. 1953 (unpublished thesis)
- map scale: 1: 24,000
- coverage: Briones Quadrangle

9) Division of Mines and Geology, Geology of Southwestern Quarter of the Walnut Creek Quadrangle, by R. Saul (open file report)
- map scale: 1: 24,000
- coverage: Walnut Creek Quadrangle (s.w. portion)

10) Geological Science, Vol. 32, No. 3, pp. 127-242 (California Publications), Lower Tertiary Foraminifera from Contra Costa County, by B.Y. Smith, 1957
- map scale: 1: 28,000

11) University of California, Berkeley, The Structure and Stratigraphy of North-Western Contra Costa County, California by J.R. Sheehan (unpublished M.S. thesis), 1956.
- map scale: 1: 24,000

12) Stanford University, San Ramon Sandstone in the Pacheco Syncline, California, by O.M. Schmidt (unpublished M.S. thesis), 1958.
- map scale: 1: 12,000

13) Division of Mines and Geology - The Calaveras Fault Zone in Contra Costa County, California, by Richard B. Saul, 1967 (Mineral Information Service Vol. 20, No. 3, March 1967)
- map scale: 1" = 5000'
- coverage: Contra Costa County

14) USGS - Preliminary Geologic Map of area covered by 7.5' North, and Jersey Island Quadrangles, by John Sims (recent work not yet published by USGS)
- map scale: 1: 62,500
- coverage: Honker Bay, Antioch North, and Jersey Island 7.5' quadrangles.

N. Slope, Slope Aspect and Elevation

Potential Interpretations: Slope stability, fire hazard, erosion hazard, air quality, wind patterns, building and service facility construction cost implications.

Sources:

1) Frank, Ernest C. and Lee, Richard, Potential Solar Beam Irradiation on Slopes.

2) USGS - Choke sheets (black-line prints of individual slope categories developed in preparation of color slope maps) - contact Gil Ogden, USGS.
- map scale: 1: 62,500

V. Base Data

Accessibility and Travel Time Network Map (1" = 2000' scale), 1973, Wilbur Smith and Associates.

Aerial Photographs and Property Maps, Contra Costa County (vertical @ 1" = 600' scale), BARTD leased from R.E.D.I. 1970 and 1972.

Aerial Photography PAX Study Area (oblique 11" x 14" black and white prints), E. Altshuler, December 1972.

Aerial Photography, Urban Areas in PAX Study Area, (1" = 2700' approximate), U.S. Department of Interior, December 1972.

Agricultural Preserves in Contra Costa County, Existing and Applications, (Non-reproducible print: 1" = 4000' scale), Contra Costa County, 1972.

Agricultural Resources Study, Supplemental Report 1S-6, Association of Bay Area Governments, October 1969.

Antioch General Plan Program Land Use Inventory, City of Antioch, Lampman and Associates, February 1973.

Antioch General Plan Program, Opinion Survey, City of Antioch, Lampman and Associates, January 1973.

Brentwood Questionnaire, City of Brentwood, May 1971.

Central Area Plan, Preliminary Economic Study, City of Concord, December 1970.

Changes in the City of Concord, City of Concord, April 1969.

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